

Performance Study if the Lowest Bidder Bid Awarding System in Government Projects – Saudi Arabia

by

Redha Amin Aitah

A Thesis Presented to the

FACULTY OF THE COLLEGE OF GRADUATE STUDIES

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DHAHRAN, SAUDI ARABIA

In Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE

In

CONSTRUCTION ENGINEERING AND MANAGEMENT

June, 1988

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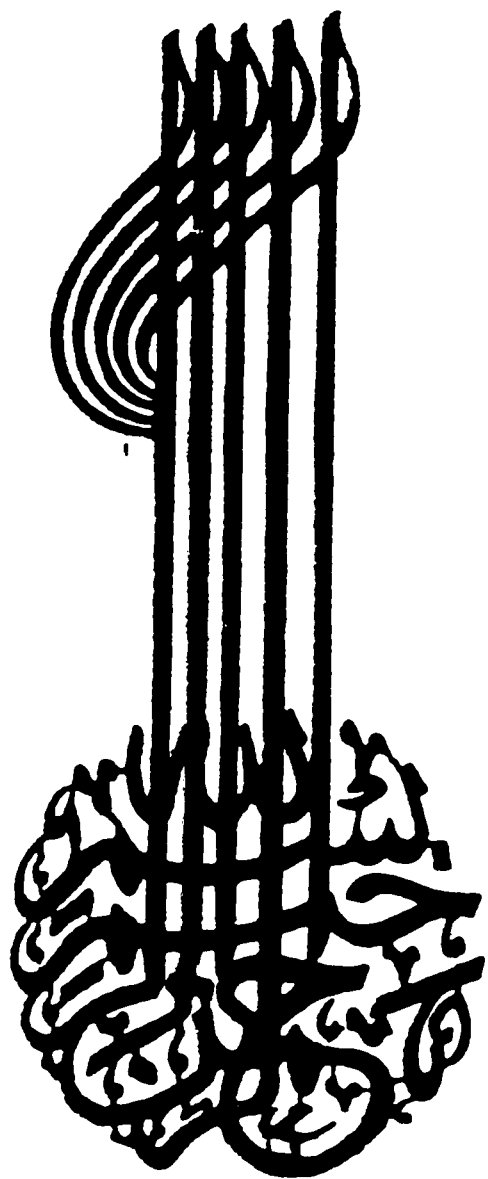
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إلى الذين كانوا معي بقلوبهم وأقوالهم وأعمالهم ... نرعى هذه النبتة
إلى الذين حرموا مني وحرمت منهم لتتضح الثمرة
إلى وطني الكبير أهدي هذه الثمرة

اللهم تقبل منا أحسن ما عملنا وتجاوز عن سيئاتنا .

رضا

**KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DHAHRAN - SAUDI ARABIA**

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Dhahran - Saudi Arabia**

June, 1988

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

DHAHRAN, SAUDI ARABIA

This thesis, written by

REDA AMIN AITAH

under the direction of his thesis committee, and approved by all the members, has been presented to and accepted by the Dean, College of Graduate Studies, in partial fulfillment of the requirements for the degree of

**MASTER OF SCIENCE IN CONSTRUCTION ENGINEERING
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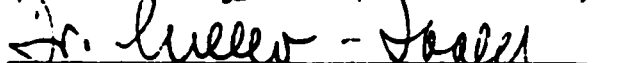
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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

خلاصة

دراسة جدوى ترسية العقود على أقل العروض في المشاريع الحكومية بالمملكة العربية السعودية

رضا بن أمين عبطه

ان الهدف الرئيس من هذه الدراسة هو التعرف على الأنظمة المتبعة في ترسية العقود بشكل عام والنظام أو الأنظمة المتبعة في المملكة العربية السعودية بشكل خاص وتقييم مشاريع إنشاء المباني التي تم تنفيذها في القطاع العام خلال السبع سنوات الماضية .

وقد تم جمع المعلومات بواسطة النموذج النهائي للإستبيان الذي وزع خصيصاً لهذا الغرض وهدف الإستبيان إلى تحديد الاعتبارات المحتملة لترسية المشاريع على أساسها وهي كون المقاول أقل العروض بإعتبار ذلك النظام السائد ، كون المقاول سبق تأهيله ، كون العرض المتقدم معقول ومنافس ، كون المقاول أكفأ المتقدمين ، كون المالك له سابق خبره جيله بقدرة المقاول ، كون المقاول مصنف لدى وزارة الأشغال العامة والإسكان .

وتم توزيع المشاريع بحسب الاعتبارات التي تم ترسيته على أساسها وذلك بتثبيت أحد الاعتبارات السابقة على أنه الإعتبار الرئيسي للترسية ولا مانع من وجود إعتبار إضافي ، وبذلك تكونت لدينا ثمانية مجموعات تم مقارنة كلا منها مع مجموعة المشاريع التي رست على أقل العروض فقط بإعتباره سبباً رئيسياً ووحيداً ، وذلك على أساس رضى المالك بشكل عام عن مستوى التنفيذ ، وأداء المقاول من حيث جودة العمل ، والإلتزام بالتعليمات والمواصفات ، وتنظيم المقاول ، نشاطه وفعاليته في متابعة العمل والتقديرات ، وتعاونه مع المالك ، وتقديم العمل ، بالإضافة إلى معدل إنذاره كتابياً ، ومعدل طلبه لعمل إصلاحات خلال فترة الضمان ، ومعدل ظهور مشاكل كبيرة بعد فترة الضمان وأخيراً مدى اعتقاد المالك أن المقاول صاحب أقل العروض كان له دور في التأثير على سير المشروع وتم تحليل نتائج هذا الإستبيان بواسطة برنامج التحليل الإحصائي المتكامل (SAS) .

لقد أوضحت هذه الدراسة أن المشاريع التي تم ترسيته على أقل العروض المتقدمة فقط دون أي إعتبار آخر كانت صاحبة أقل التقديرات بشكل عام بين بقية مجموعات المشاريع الأخرى والتي رست لإعتبارات أخرى .

ABSTRACT

PERFORMANCE STUDY OF THE LOWEST BIDDER BID AWARDING SYSTEM IN GOVERNMENT PROJECTS - SAUDI ARABIA

by

REDHA AMIN AITAH

The main objectives of this research are to study the various bid awarding systems available in general, and in Saudi Arabia in particular and to evaluate public building construction projects in Saudi Arabia which have been awarded to the lowest bidder through the final questionnaire form that has been distributed for this purpose.

The questionnaire consists mainly of three major parts. The first part is an identification of the project name, dates, and costs. The second part identifies the performance of the contractor and owner's impression. The third part identifies the criteria used to award the project.

According to the third part of the questionnaire, eight groups were formed according to the awarding criteria, which were the contractor being the lowest bidder as is Government practice, the contractor being prequalified, the contractor's offer being nearest to estimated cost, the contractor's offer being the most competent, the owner having good experience with the contractor, and the contractor being classified by the Ministry of Public Works and Housing.

Each group was compared with the group projects awarded to the lowest bidder as is government practice.

All data was statistically analysed by the statistical analysis system package (SAS). It was found that the projects awarded to the lowest bidder only had in general a lower performance evaluation than that of the other groups of projects that have been awarded with a specified qualification. Finally, a set of recommendations is given and topics for further studies are suggested to improve the lowest bidder bid-awarding system.

Chapter 1

INTRODUCTION

1.1 General

In the construction industry there are two approaches to construction planning stage: linear and phased. Linear construction refers to the procedure of design, bidding or negotiation, and construction following one another in strict order. Phase construction, or fast-tracking, refers to the overlapping accomplishment of project design and construction.

After the planning stage, the project is designed by a professional designer who provides complete, plans and specifications, either for the whole project or for some phases. The bid announcement is issued to newspapers for an open invitation to all bidders, or it might be restricted to selected firms which are specialized in this type of projects. The open invitation could be for prequalification purpose where owner (clients) can select qualified contractors based on specified standards.

All submitted offers are opened on the announced date and evaluated on the basis of submitted documents which are sometimes verified by the client before contract awarding. This verification might include contractors' offices, previously executed projects and users of these past projects.

The next stage is awarding the contract to the successful bidder. The client then assigns a professional supervisory group or supervises the work himself from the first day of execution until the initial receiving of the project.

The closer attention to details and procedures the owner pays, the more he will be satisfied with the executed project. This satisfaction will be affected by the percentage of careful application of any of the project implementation stages. However, if the awarding stage is not conducted properly or careful selection of the contractor is not carried out, whatever effort the client puts or already has put into the other stages, the client will end up with less satisfaction.

In Saudi Arabia, the Government is the major source of construction expenditure, accounting of approximately 67% of construction industry volume. (9).

Under Saudi rules, public construction works are undertaken by contractors on the basis of open competitive tendering and contracts are awarded to the lowest bidder.

Beginning in 1403H, open tendering on government construction contracts was more strictly enforced in order to increase the access of Saudi contractors to government construction work and reduce, through increased competition, the cost of government construction programs. (9).

1.2 Problem

As the contract is awarded to the lowest bidder without any qualification, in most cases, he will try to minimize his losses in this project or maximize his low profit by construction quality below contract level. In all cases, someone will pay for this low price; either the owner by getting a low quality project or the contractor who will have to choose between stopping the work to argue with the owner, which might lead to claims, and choosing to complete the project from his own account if he has a sound financial status. Otherwise, this project might lead the contractor to bankruptcy.

This system has created many problems and ultimately leads to unsatisfactory results for parties involved in the project implementation.

1.3 Previous Studies

Several studies have been conducted to measure the performance of construction contracts using time, cost and disputes as parameters. Surinder Singh and G. C. Sofat (25) analysed the performance of various contracting systems in use in India to select the appropriate type of contract to obtain maximum economy in cost of construction. Their paper describes in quantitative terms the comparative performance of the lump sum, the percentage rate and the item rate contract. The study reveals the lump sum contract to be a

more efficient contracting system in India.

Purushatoom S. Gore (21) discussed the rationale of contract awards and contract systems and the analysis of the construction industry at the government level in India. The emphasis of his paper was on the selective use of current contract system with suggestions for adopting a simple formula derived to decide the best bid. He concluded that indiscriminate use of a single system, with a swaying of the decision to award a contract to a lowest bidder on the face value, have invariably been one of the major causes of higher completion cost.

James E. Diekmann (14) developed a method of organizing, comparing, and measuring the performance qualification of cost-plus contractors. The methodology uses the concept of decision theory and value theory to model the performance potential of contractors competing for a cost-plus contract. Two models are formulated; the first, the worth model, is a deterministic representation of a contractor's performance potential. The second model, the utility model, allows the risk of variable contractors' performance and the owners' attitude toward this risk to be incorporated into the formulation. The methodology is demonstrated using a simplified contractor selection situation and the results of both models are compared and contrasted. The methodology is viewed as an aid to owners and agencies who must make rational, consistent decisions when selecting cost-plus contractors.

Peter H. Grinyer and John D. Whittaker (19) extended the basis Friedman model to allow for basis in cost estimates and the use of management judgement on market trends. The estimated mean bid is used as a parameter. Simulation, using data from four construction companies, is used to evaluate the performance of the resulting model. A sensitivity analysis is used to determine the required accuracy for the management estimate. A brief account is given for the introduction of the model as a practical tool of top management in a major construction firm.

1.4 Objectives

The main objectives of this research are to:

- 1) Study the various bid awarding systems available.
- 2) Test the hypothesis that "public building construction projects in Saudi Arabia that have been awarded to the lowest bidder only have in general a lower performance evaluation than of that of the other projects that have been awarded with a specified qualifications".

1.5 Procedures and Methodology

The initial phase of this research involves a study of available bid awarding systems which are:

Lowest Bidder: essentially, all public works are done by open competitive bidding where all contractors use the same proposal form provided with the bidding documents. The contract is awarded to the lowest proposal amount (contractor's final offer), and there is no subsequent bargaining or negotiation.

Nearest to the average of all bids received: this is used in some European countries and may be represented by this equation:

$$\text{Successful bidder} = \frac{\sum \text{All bid amounts received}}{\text{Number of participating bidders}}$$

Limited by average of all bids received and owner's estimates: in an Asian nation the successful bidder is the one who is nearest to the average of all bids received and at the same time below the owner's estimate.

Danish System: a formula was developed in Europe known as the Danish system to decide a reasonable offer from several competitive bids. The lowest and highest offers are rejected and the rest of the offers are considered. The formula used is:

$$NA = (NL + 4A + NH)/6$$

where NA = new average; NL = new low; NH = new high; and A average of all offers.

The offer which is first above this new average is then treated as realistic and acceptable.

German System: where government offices keep records of all previous projects, usually in a computer system, which include the contractors' unit prices. To award a new project, the latest average (current year) of lowest bid unit prices is called up and compared with each contract's unit prices. The lowest bidder is heavily scrutinized if he is below this average.

Negotiated Offer: sometimes used by private owners, this is where competitive bidding is closed to some contractors. There is no prescribed opening. Qualifications are required to be submitted along with the offer. The owner selects one of the proposals submitted or perhaps interviews those contractors whose proposals appear most advantageous and negotiates a contract with one of them.

The second phase involves gathering of data through interviews and discussions with owners. These preliminary interviews with owners, together with information obtained from literature research, have led to the formulation of the attached questionnaire (see Appendix A).

In this study, the questionnaire will be distributed to owners. Each questionnaire will be limited to one project which will be evaluated according to the way it was awarded as shown in Question 12 of questionnaire in Appendix 'A'.

1.6 Scope

The scope of this research is limited to the identification of the performance of the lowest bidder on government projects executed in the Eastern Province, Saudi Arabia.

Chapter 2

BID AWARDING SYSTEM

2.1 General

Construction work is usually accomplished through a contractor who signs a contract with the owner. This contract fully describes the nature of the construction to be accomplished. The contractor is entitled to payments as per the agreement. The owner may select the contractor either through competitive bidding, negotiation, or a combination of the two.

2.2 Lowest Bidder

One of the most commonly applied systems for contract awarding is to the lowest bidder. It comes under competitive bidding, through which a large number of contractors obtain their work in construction and generally all public works are done by this method.

The main objective behind using competitive bidding is to encourage efficiency and innovation by contractors, which will lead to a constructed project of specified quality at the lowest possible price. However, "competitive bidding sometimes leads to the selection of incompetent contractors, excessive claims by the contractor against the owner, disputes and litigation between two parties, bid shopping,

and other problems" (6). Although there are two types of competitive bidding ("open" and "closed") award of contracts to the lowest bidder is done through "open" competitive bidding. In open bidding, all contractors use the same proposal form provided with the bidding documents and the bids are open publicly to avoid imputations of favoritism. In closed bidding, no prescribed proposal form is used and there is no public opening of bids.

2.3 Nearest To The Average Of All Bids Received

This is another system of bid awarding that comes under open competitive bidding. In this system once the owner has received the offers of all participants he does a simple mathematical calculation to find the average bid value (A.B.V.) where all the participants' offers are summed and divided by the total number of bids received (Eq. 2.1).

$$(A.B.V.) = \frac{\sum \text{Participants Offers}}{\text{Number of BidsReceived}} \quad \text{Eq. 2.1}$$

To award the contract, the owner looks for the nearest offer to the average bid value (A.B.V.) and considers this the successful bid for the award of the contract. Through this system, used in some European countries (6), the owner is trying to avoid low bidders who have not studied the contract carefully or do not have enough experience, and to avoid overestimated bids. On the other hand, the

owner will probably not have enough information about the degree and the type of experience the successful bidder has.

2.4 Limited by Average Bid and Owner's Estimate

This is another open competitive bidding system for bids awarding. Whereas in the previous system all bids received are summed and the summation is divided by the number of bids received to get the average bid value (A.B.V.), the owner also through his own resources and experience has estimated the project cost.

To award the bid, the owner reviews all the participating offers and looks for the offer nearest to the average bid value (A.B.V.) but which, at the same time, does not exceed his estimated cost (Eq. 2.2). The offer that satisfies these two requirements is the successful bid and the one to be awarded the contract.

$$\text{Owner's estimate} > \text{offer of successful bidder} \leq (\text{A.B.V.}) \quad (\text{Eq. 2.2})$$

This system might not have a brighter future than the previous one except perhaps insofar as the successful bid is between the owner's estimate and the average bid the system may give the owner some indications about the seriousness of the offer and the contractor's understanding of the project of documents both of which qualities are reflected in his reasonable offer.

2.5 Danish System

This is also another system of bid awarding that is under the umbrella of open competitive bidding. It was developed in Europe and is known as the Danish System (21), which is a simple formula to select the most reasonable offer from the competitive bids received. As in the previous system, this system also avoids the two extreme offers (highest and lowest) which were rejected. A new highest and lowest offer will exist, and a new average (NA). The rest of the offers are considered in relation to the new highest offer (NH). The new lowest offer (NL) and the average (A) of the all offers are calculated. The new average (NA), which will help in selecting the successful bidder, is calculated as follows;

$$NA = (NL + 4A + NH)/6 \quad \text{Eq. 2.3}$$

The offer which is first above this new average is then treated as realistic and acceptable.

2.6 German System

Bidding and Tendering in West Germany is regulated by two books of norms by the Deutshes Institute (German Institute for Establishing Norms) DIN 1960, (General Rules for Bidding and Tendering) (7), DIN 1961, (Rules for Contracting Construction Work) (8). The principles of these rules are as follows:

- 1) In the normal case, contracting should be done in separate contracts with each specialized firm such as the construction firm or mason, the firm constructing the facade, windows, and doors, and firms specialized in plumbing, electrical works, central heating and air conditioning and so on.
- 2) The contracting should be specialized items by item.
- 3) Contracting by lump sum for public authorities (even in the smaller packages) is strictly forbidden. The rules of DIN 1960 and DIN 1961 are not binding for private contracting yet in by far the majority of cases in private contracting these rules are applied and in a specific chapter of the contract declared as a binding part of the contract.
- 4) The bidding and tendering in general is an open process. The project will be publicly announced (for larger projects all over the countries of the European Common Market). The public authority or the private owner concerned will supply the bidders with the necessary detailed plans and specifications, so that the bidding is based on exactly comparable construction. The kind of exactness of plans and specifications is defined in DIN 1961. Alternatives are acceptable. In such cases, both the original construction and the alternative must be calculated and the alternative handed in with all details of construction.
- 5) The opening of the proposals is done in a public proce-

dure, which has to be announced sufficiently in advance. The bidders have to be invited directly.

- 6) The contract in normal cases has to go to the most economical bidder. This means that the life-cycle cost of later maintenance will have to be considered. This also means that the cheapest bidder does not always get the contract.
- 7) In order to evaluate the proposal of the bidder and to judge reasonable prices, most public authorities computerize their contracting results. By such measures, the authority is able to have an overview of the current average pricing, section by section and item by item. If the bidder goes far below such price averages he will be scrutinized heavily regarding his reliability, financial backing and economic potential. If there is any doubt in such a case, the bidder with the price closest to the average of the previous contract is liable to get the contract.
- 8) If an investor (private or public) has publicly announced a bidding and tendering procedure and bidders have received the appropriate material as well as handed in an offer or proposal, by West German legal rules a preliminary contract between the investor and all bidders has come into effect. Only under certain conditions can either party get out of this. These rules are set up to:
 - achieve a general procedure of efficiency operating

bidding, tendering and contracting.

- protect those who are not sufficiently trained in such matters.**
- avoid wild bidding and tendering operations on both sides, and**
- prevent by system and procedure either of the sides or partners making unjustified losses as a result of speculative bidding, tendering and contracting.**

- 9) When the contract has been signed and the implementation is started, the construction work is heavily controlled on site by the Construction Manager.**
- 10) In West Germany the construction management of public buildings or infrastructure objects will be performed by the respective public agency itself. Only in extremely unusual cases the public agency might engage a highly specialized competent private construction management firm. In private buildings a private construction manager (in general a Civil Engineering or Architectural firm) will perform the management of construction.**

2.7 Negotiated Offer

Where the owner negotiates the contract with a preselected contractor or group of contractors, this means he may go through the competitive process entirely and handpick the contractor on the basis of reputation and overall qualifications to do the job. The forms of such contracts are almost limitless because they could include many provisions that are best suited to the particular work involved and are agreeable to both parties. "Negotiated contracts are normally limited to privately financed work because competitive bidding is a legal requirement for most public projects except under extraordinary or unusual application of negotiated contracts across the board in the private sector. This can only be interpreted as a sign that owners are increasingly finding that such arrangements are in their best interest." (6)

2.8 Awarding System in Saudi Arabia

All bidders are informed either through at least two public announcements in the official newspapers, or through private invitation in the case of limited bidding. The offers are opened on the date announced for bids opening by the envelopes opening committee. The offers are publicly read. For construction work, at least five classified contractors in the required class are invited to submit their offers within a month's time. The date and time of opening is fixed. All offers are sent to the bids evaluation committee which awards the

contract to the lowest bidder who satisfies contract conditions and specifications unless the offer is very low and there is concern that the project will not be completed. The evaluation committee may negotiate with the lowest bidder if the price is very clearly higher than the market prices, to lower his prices to make it reasonable. Also the committee may negotiate with the lowest bidder, if he includes some limits in his offer, to withdraw his limits. In either case, if the lowest bidder does not agree with the committee, the negotiation moves to the second lowest, and so on until the best offer is selected. (17)

Chapter 3

THE SURVEY

3.1 Introduction

The survey was done using questionnaire forms. Each questionnaire was limited to one project and they were designed starting with a preliminary interview with some owners at different levels of management. These interviews, along with the author's experience led towards the important questions that came out in the preliminary questionnaire which was distributed to some Government sectors to fill out. From those answers, it was felt that some of the questions were not clear and some other questions should be asked to clarify the picture about each project. This was carried out in the final form of the questionnaire.

3.2 Final Questionnaire Form

The questionnaire consists mainly of three major parts. The first six questions from the first part, which is an identification of the project, name, dates and costs (see Appendix A). The second part was formed to identify the performance of the contractor. The main question (Q) in this part is number 10 (Q.10), which evaluates the contractor's quality of work, adherence to instructions and specifications, organization, activity (work follow-up and submissions),

cooperation with owner and progress of work. Each of these has five alternative answers ranging from 'excellent' to 'poor'. The other questions in this part are supplementary. (Q.7), asked about the number of participating bidders to find out if there is a relationship between the number of participating bidders and the awarding system. (Q.8) was a direct question about the client's satisfaction with the overall quality of work completed. Five answers were given ranging between 'excellent' and 'poor'. (Q.9) asked about who supervised the project. This was to find out if there is a relationship between the contractor's performance (Q.10) and project supervision (Q.9). (Q.11) asked about the rate of issuance of written warnings to the contractor. The five answers ranged from 'very often' to 'never'. (Q.13) was to give the interviewee the chance to express what he feels is required to improve the lowest bidder bid awarding system. (Q.14) checked if there was any estimate done for the project or not and whether it was done up to date or if it was outdated. (Q.15) was used to measure the rate of warranty calls received by the contractor which could give an indication about the quality of work he performed. (Q.16) asked about the rate of major problems faced after the warranty period. It also gives an indication about the quality of work performed, but in the long term, after the warranty period.

(Q.17) was a direct question to the clients to find out what their opinions were about the extent to which the lowest bidder system affected the project executed by them. the answers ranging

between 'very much' and 'none'.

The third part consists of one question only (Q.12), which identifies if there were any requirements used for the selection of the successful bidder who was awarded the project, assuming the lowest bidder system is the prevalent system used in the Kingdom of Saudi Arabia. Eight answers indicated that the contract was awarded to the lowest bidder for one or more of the following reasons: because it was government practice, because the contractor was prequalified, because the contractor's offer was the closest to the client's estimate, because the contractor's offer was a reasonable competitive offer (there being no large difference from others), because the contractor was more competent than the other contractors, because the contractor was classified, or for any other reason not mentioned here.

3.3 The Statistical Results

The author distributed the questionnaires to Government sectors involved primarily in building construction projects. The respondents who answered the questionnaires were primarily engineers of different backgrounds. All the questionnaires were discussed during interviews with the respondents.

The author received and collected a total of 154 completed questionnaires. Twenty-three questionnaires were disregarded, either because they contained incomplete information or because they

were not related to building construction projects. Among the remaining 131 questionnaires, the answers to some of the identification (Group 1) questions (Q5 and Q6) do not clarify whether the excess or the shortfall in cost or in time spent on the project execution were official or not. Through the interview, the author felt that owners were most likely to give their contractors more time even if they took double the original period or more. Moreover, they would consider it official. The difference in costs is limited to 10% maximum excess and 20% reduction as per Government rules. (17) Because of all these reasons, it was decided not to analyze Questions 5 and 6. Also, Questions 7 and 14 of Group 2 were not analyzed because they were not answered in most of the questionnaires. Therefore, the analysis was limited to Questions 1, 2, 3, 4, 8, 9, 10, 11, 12, 13, 15, 16, and 17.

The 131 questionnaires were statistically analyzed by SAS (the Statistical Analysis System) on the KFUPM main frame computer (the IBM 370 operating system). SAS was mainly used for finding the relative frequency, the standard error, t - statistic, and the probability of an absolute value greater than t . Different SAS programs were written and processed so that the results appeared in tabular and graphical form (see Appendix B, Computer Program).

3.4 Results Evaluation System

As mentioned before in Section 3.2, some of the questions were given five possible answers. The respondent should select only one of these answers. Each answer was given a value from 1 to 5. Where the first answer was given a value of 1, the second one was given a value of 2 and so on. This is applicable to (Q.11), (Q.15), (Q.16) and (Q.17). In these questions, it was meant to give the lowest value to the worst answer and vice versa. This can be clarified as follows:

<u>OPTION</u>	<u>VALUE</u>
Very often	1
Often	2
Sometimes	3
Not much	4
Never	5

This is a sample answer for (Q.11).

In (Q.8) and (Q.10), the highest value 5 was given to the 'excellent' answers, 4 to 'very good', 3 to 'good', 2 to 'fair', and 1 was assigned to the 'poor' answers. This system of grading will yield the highest evaluation for the best contractor and vice versa. (Q.12) was evaluated from 1 to 8 to indicate the combination of requirements used to award the contract. (Q.9) was given codes from 1 to 3 to indicate the supervisory group, with 1 being the client, 2 the con-

sultant, and 3 others, (Appendix A).

The following section contains the computer results of the questionnaires included with a summary of the results and some discussion of the information given in the means tables, t-values tables, probability table, and some of the selected information given by the most relevant relative frequency and gross frequency tables.

3.5 Discussion of the Statistical Results

From the answers to (Q.12), eight groups or combinations of different awarding systems were formed as follows:

Group No. 1: includes all projects awarded to the lowest bidder according to government practice only (L.B.O.). The total number of projects in this group was 22.

Group No. 2: includes all projects awarded to the lowest bidder according to government practice and any other requirements (L.B. & O.R.). The total number of projects in this group was 111.

Group No. 3: includes all projects awarded to the lowest bidder because he was prequalified by the owner and may satisfy other requirements (L.B. & P.). The total number of projects in this group was 24.

Group No. 4: includes all projects awarded to the lowest bid-

der as his offer was close to the owner's estimate and he may satisfy other requirements (L.B. & C.T.E.). The total number of projects in this group was 16.

Group No. 5: includes all projects awarded to the lowest bidder as his offer was the most reasonable and competitive (no large difference from others) and he may satisfy other requirements (L.B. & R.C.). The total number of projects in this group was 23.

Group No. 6: includes all projects awarded to the lowest bidder as he was the most competent and he may satisfy other requirements (L.B. & M.C.). The total number of projects in this group was 12.

Group No. 7: includes all projects awarded to the lowest bidder as the client (owner) had good experience with him and the contractor may satisfy other requirements (L.B. & G.E.). The total number of projects in this group was 14.

Group No. 8: includes all projects awarded to the lowest bidder as he was classified by the Ministry of Public Works and Housing and he may satisfy other requirements (L.B. & C.). The total number of projects in this group was 93.

In the analysis stage, Group 1 (L.B.O.) was compared with the other groups (2, 3, 4, 5, 6, 7, 8) one by one on the basis of Questions 8, 9, 10, 11, 15, 16 and 17. The comparison is made on the basis of the average performance of each group. The average performance for each question is computed

as follows: Suppose, for Question 10 (see Fig. 3.1), we have n_1 'poor' answers, n_2 'fair' answers, n_3 'good' answers, n_4 'very good' answers, and n_5 'excellent' answers. As explained in Section 3.6, the values of 5 to 1 were given to the answers from 'excellent' to 'poor'.

$$\text{The average performance} = \frac{5(n_5) + 4(n_4) + 3(n_3) + 2(n_2) + 1(n_1)}{n_5 + n_4 + n_3 + n_2 + n_1}$$

The same calculation is done for Question 8 to find the average owner's satisfaction with the overall quality of work executed by that group of contractors, and (Q.9) to find out if supervision affected the average performance of that group of contractors.

In (Q.11) the calculation can be used to find the average rate of issuing written warnings to the contractors awarded contracts on the basis of that specific group, and in (Q.15) it can find the average number of requests which that group of contractors received to attend warranty calls during the warranty period. In (Q.16), it can find the average rate of major problems faced after the warranty for the projects executed by that group of contractors, and in (Q.17) it will find the average owner's opinion of the degree extent to which he feels that this group of contractors affected the execution of the projects they constructed.

(Fig. 3.1): Illustration of Question No. 10.

Assume the following answer was given by ten respondents in Group 1:

Question 10: Performance of Contract

	<u>Excellent</u>	<u>Very Good</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>
Quality of Work	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Adherence to instructions & specifications	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organization	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Activity (work follow-up and submissions)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cooperation with Owner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Progress of Work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Total	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
	$n_5=10$	$n_4=20$	$n_3=10$	$n_2=10$	$n_1=10$

$$\text{Average Performance} = \frac{5(n_5) + 4(n_4) + 3(n_3) + 2(n_2) + 1(n_1)}{n_5 + n_4 + n_3 + n_2 + n_1}$$

$$= \frac{5(10) + 4(20) + 3(10) + 2(10) + 1(10)}{10 + 20 + 10 + 10 + 10}$$

$$= \frac{190}{60} = 3.1667$$

The averages of the two groups are compared with each other to find the lowest.

To make sure that the difference between the two averages is considerable (significant), a null hypothesis was set up that the two averages are equal. The t-statistic at α -level of significance was calculated to test the equality of the two means against the alternative hypothesis that (L.B.O.) mean < other group mean. Symbolically, we state, for example that:

$$H_0 : \mu_L = \mu_o$$

versus

$$H_A : \mu_L < \mu_o$$

where μ_L denotes (L.B.O.) mean and μ_o denotes any of the other groups's mean.

The positive t-value indicates the unequal averages (mean). The negative t-value indicate that (L.B.O.) has higher average (mean) than the other group and as such no test is necessary.

The level of significance (Prob ($|T| > t$)) will indicate the level at which null hypothesis (equality of two bidding systems) is rejected. The rejection of null hypothesis will show that (L.B.O.) mean is statistically smaller than other group mean.

Q.9 was evaluated against Q.10 to check if the performance of the contractors of any of the eight combinations improves or not when the supervision is done by the client (owner), the consultant, or any other.

The answers to Q.13, respondents' suggestions to improve the lowest bidder bid awarding system, are listed at the end of this chapter.

3.5.1 *Evaluation of Projects Awarded to the Lowest Bidder as Government Practice only (L.B.O.) and Projects awarded to the Lowest Bidder and because of Other Requirements (L.B. & O.R.)*

In Table (3.1), we give all statistical computations for testing H_0 against H_A in case of questions No. 8, 10, 11, 15, 16 and 17. Some comments and results are given below.

3.5.1.1 Owner's Satisfaction:

The difference between the two averages is valid at 0.68 level of significance, which means that the average owner's satisfaction with the overall quality of work executed by (L.B. & O.R.) is higher than (L.B.O.) contractors. This is true up to 32%. The two averages are graphically presented in Fig. 3.2.

3.5.1.2 Performance:

The difference between the two averages is valid at 0.68 level of The difference between the two averages is very small which

Table 3.1: Evaluation of Projects Awarded to (L.B.O.)
vs. Projects Awarded to (L.B. & O.R.)

Variable	Awarding System	Number of Projects	Mean (Average)	Std. Dev.	Std. Error	T	DF	Prob.
(Q8) Owners Satisfaction	L.B. & O.R.	111	3.18918919	0.99556757	0.09449509	0.4120	131	0.6810
	L.B.O.	22	3.09090909	1.15094540	0.24538238			
(Q10) Performance of Contractor	L.B. & O.R.	111	2.82882883	0.98073861	0.09308759	0.0791	131	0.9370
	L.B.O.	22	2.81060606	1.01743460	0.21691779			
(Q11) Written Warnings issued to Contractor	L.B. & O.R.	111	3.69369369	1.19691112	0.11360578	0.8530	131	0.3952
	L.B.O.	22	3.4545455	1.22386090	0.26092802			
(Q15) Request to Attend Warranty Calls	L.B. & O.R.	111	3.03603604	1.32066050	0.12535155	(-)0.4808	131	0.3685
	L.B.O.	22	3.18181818	1.18065211	0.25171587			
(Q16) Major Problems after Warranty Period	L.B. & O.R.	111	3.23423423	1.96771651	0.18676739	(-)2.2713	131	0.9752
	L.B.O.	22	4.22727273	1.26986382	0.27073588			
(Q17) Extent of Effect on Project Execution	L.B. & O.R.	111	2.21621622	1.33760577	0.12695992	(-)1.3531	131	0.8216
	L.B.O.	22	2.63636364	1.29266998	0.27559817			

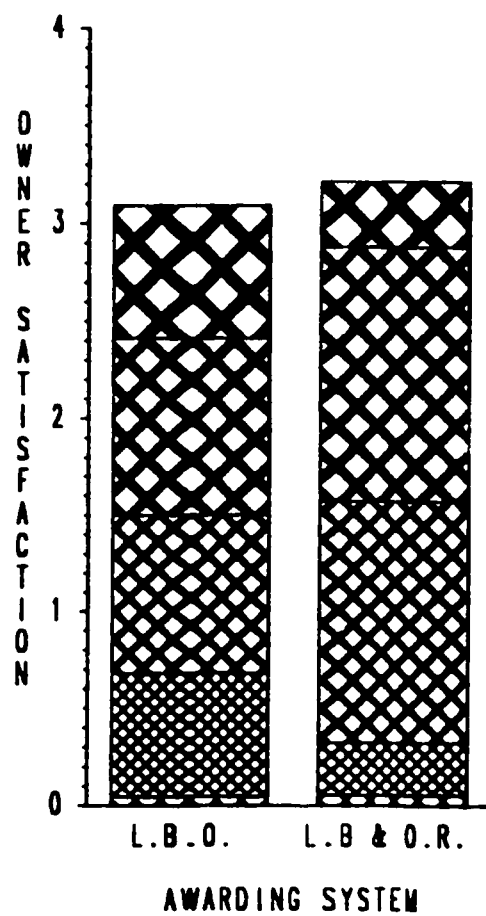


FIGURE NO 3.2 OWNER SATISFACTION VS.BID AWARDING SYSTEM

means that both (L.B.O.) and (L.B. and O.R.) contractors perform equally well. The two averages are graphically presented in Fig. 3.3.

3.5.1.3 Rate of Issuance of Written Warnings:

The difference between the two averages is significantly different at 0.40 level of significance. This means that the written warnings received by (L.B.O.) is higher than that of (L.B. & O.R.). This is true up to 60%. The two averages are graphically presented in Fig. 3.4.

3.5.1.4 Rate of Requests to Attend Warranty Calls:

The requests to attend warranty calls during the warranty period for (L.B.O.) contractors is less than the rate of requests for (L.B. & O.R.) contractors. The two averages are graphically presented in Fig. 3.5.

3.5.1.5 Rate of Facing Major Problems after Warranty Period:

The average number of major problems which have been faced after the warranty period in projects awarded to (L.B.O.) contractor is more than the average of (L.B. & O.R.) contractors, which means that the (L.B. & O.R.) system causes more major problems after the warranty period than the (L.B.O.) system. The two averages are graphically presented in Fig. 3.6.

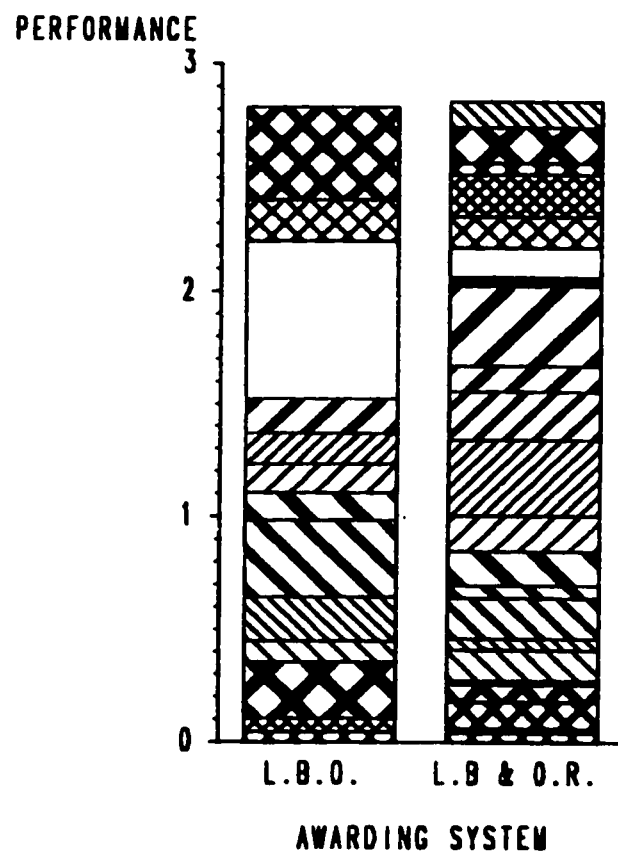


FIGURE NO 3.3 PERFORMANCE VS.BID AWARDING SYSTEM

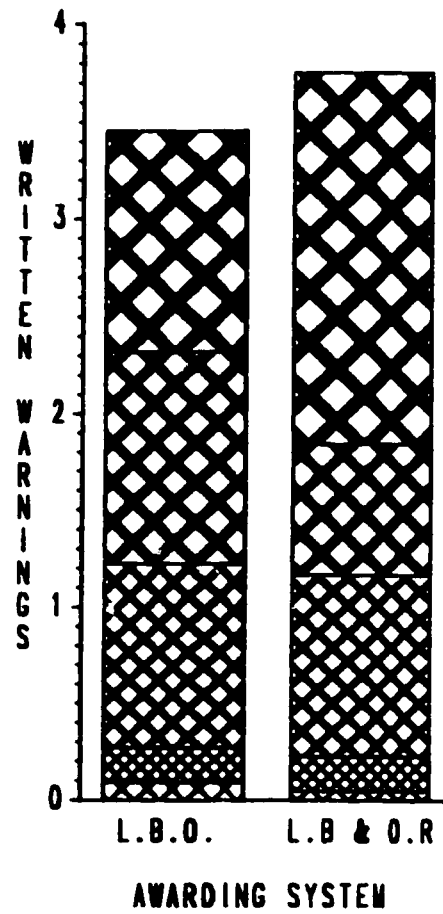


FIGURE NO 3.4 WRITTEN WARNINGS VS. BID AWARDING SYSTEM

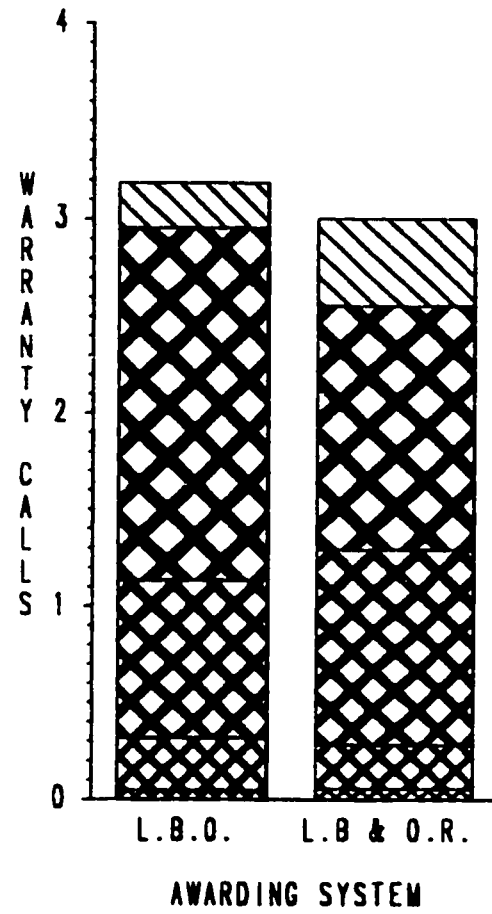


FIGURE NO 3.5 WARRANTY CALLS VS. BID AWARDING SYSTEM

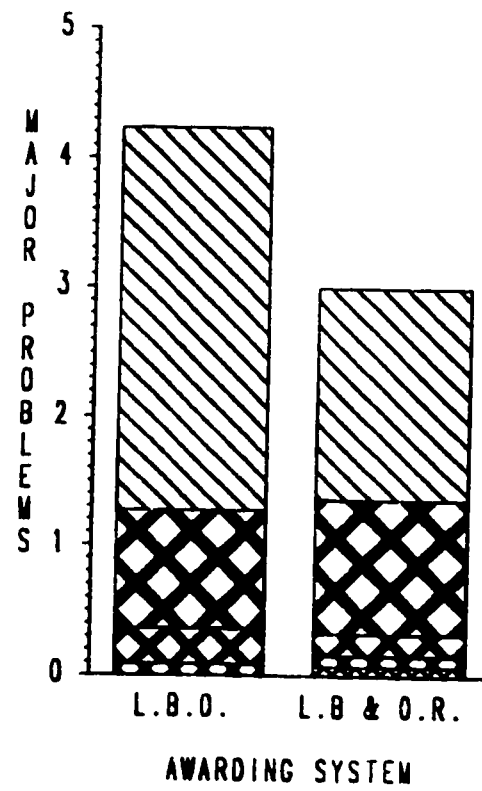


FIGURE NO 3.6 MAJOR PROBLEMS VS. BID AWARDING SYSTEM

3.5.1.6 Extent of Effect on Project Execution:

The average effect of the (L.B.O.) contractor on project execution is more than the average effect of (L.B. & O.R.) contractors. In other words, the (L.B. & O.R.) contractors affected the execution of projects awarded to them more than the (L.B.O.) contractors. The two averages are graphically presented in Fig. 3.7.

3.5.2 *Evaluation of Projects Awarded to the Lowest Bidder as Government Practice only (L.B.O.), and Projects Awarded to the Prequalified Lowest Bidder (L.B. & P.)*

In Table (3.2), we give all statistical computations for testing H_0 against H_A in case of questions No. 8, 10, 11, 15, 16 and 17. Some comments and results are given below.

3.5.2.1 Owner's Satisfaction:

The difference between the two averages is significantly different at 0.02 level of significance, which means that the average owner's satisfaction with the overall quality of work executed by (L.B. & P.) contractors is very much higher than that of (L.B.O.) contractors. This is true up to 98%. The two averages are graphically presented in Fig. 3.8.

3.5.2.2 Performance:

The difference between the two averages is highly significantly different at 0.011 level of significance. This means that the average performance of (L.B. & P.) contractors is very much higher than the

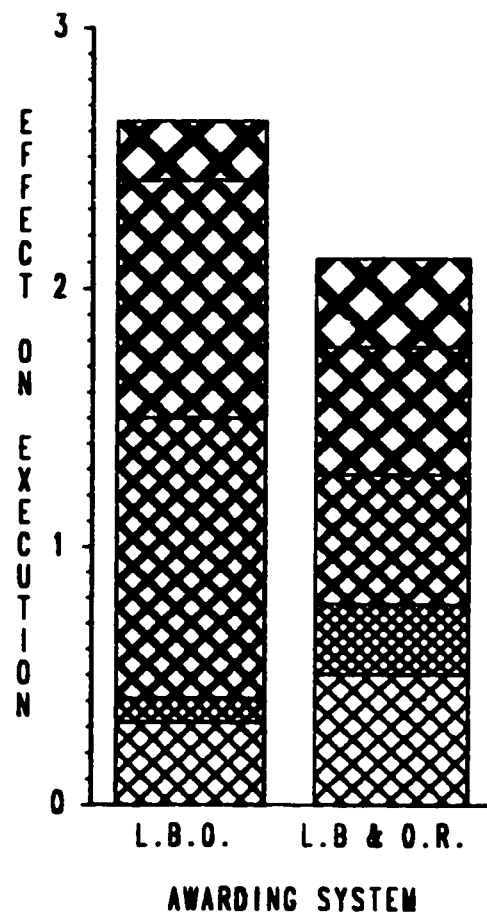


FIGURE NO 3.7 EFFECT ON PROJECT EXECUTION VS.BID AWARDING SYSTEM

Table 3.2: Evaluation of Projects Awarded to (L.B.O.)
vs. Projects Awarded to (L.B. & P.)

Variable	Awarding System	Number of Projects	Mean (Average)	Std. Dev.	Std. Error	T	DF	Prob.
(Q8) Owners Satisfaction	L.B. & P.	24	3.91666667	1.10006587	0.22455001	2.4876	44	0.0167
	L.B.O.	22	3.09090909	1.15094540	0.24538238			
(Q10) Performance of Contractor	L.B. & P.	24	3.60416667	0.20308919	0.20308919	2.6732	44	0.0105
	L.B.O.	22	2.81060606	0.21691779	0.21691779			
(Q11) Written Warnings issued to Contractor	L.B. & P.	24	3.91666667	0.24014388	0.24014388	1.3054	44	0.1985
	L.B.O.	22	3.45454545	0.26092802	0.26092802			
(Q15) Request to Attend Warranty Calls	L.B. & P.	24	3.16666667	0.29895147	0.29895147	(-)0.0384	44	0.9695
	L.B.O.	22	3.18181818	0.25171587	0.25171587			
(Q16) Major Problems after Warranty Period	L.B. & P.	24	3.75000000	0.36737415	0.36737415	(-)1.0304	44	0.6915
	L.B.O.	22	4.22727273	0.27073588	0.27073588			
(Q17) Extent of Effect on Project Execution	L.B. & P.	24	3.45833333	0.32957574	0.32957574	1.8947	44	0.0647
	L.B.O.	22	2.63636364	0.27559817	0.27559817			

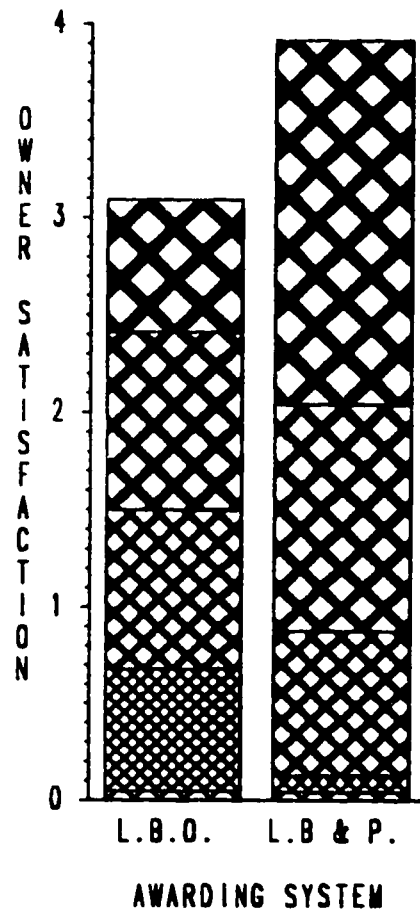


FIGURE NO 3.8 OWNER SATISFACTION VS.BID AWARDING SYSTEM

average performance of (L.B.O.) which is true up to 98.95%. The two averages are graphically presented in Fig. 3.9.

3.5.2.3 Rate of Issuance of Written Warnings:

The difference between the two averages is significantly different at 0.20 level of significance, which means that the average number of written warnings received by (L.B.O.) is higher than the average of (L.B. & P.). This is true up to 80%. The two averages are graphically presented in Fig. 3.10.

3.5.2.4 Rate of Requests to Attend Warranty Calls:

The average for (L.B. & P.) contractors is lower than the average for (L.B.O.) contractors. This shows that (L.B. & P.) contractors received more requests to attend warranty calls than (L.B.O.) contractors during the warranty period. The two averages are graphically presented in Fig. 3.11.

3.5.2.5 Rate of Facing Major Problems after Warranty Period:

The average of (L.B. & P.) contractors is lower than the average of (L.B.O.) contractors. This shows that (L.B. & P.) contractor cause more major problems after the warranty period than (L.B.O.) contractors. The two averages are graphically presented in Fig. 3.12.

3.5.2.6 Extent of Effect on Project Execution:

The difference between the two averages is highly significantly

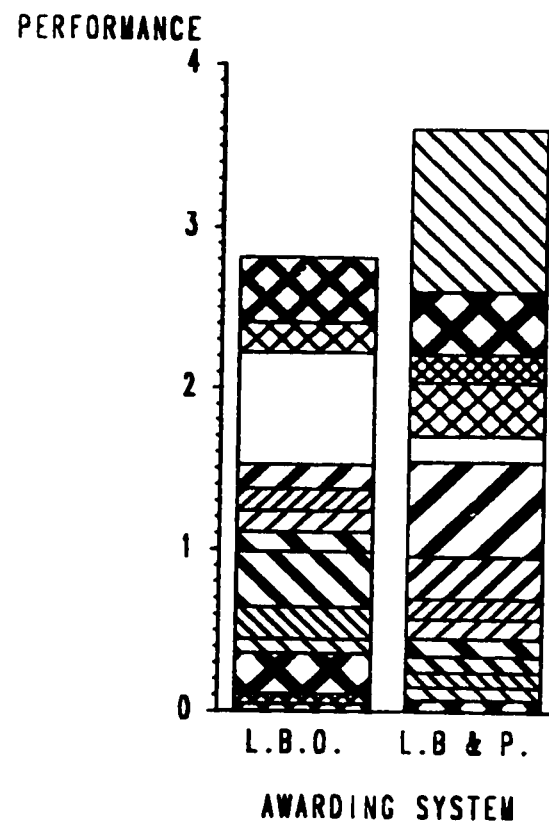


FIGURE NO 3.9 PERFORMANCE VS.BID AWARDING SYSTEM

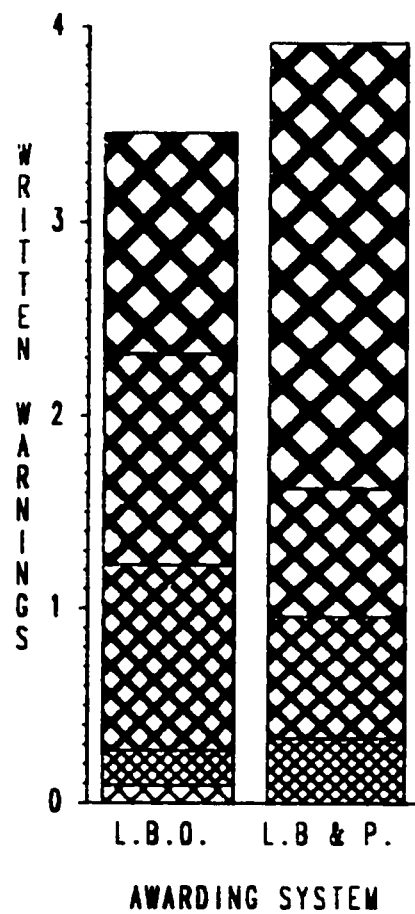


FIGURE NO 3.10 WRITTEN WARNINGS VS. BID AWARDING SYSTEM

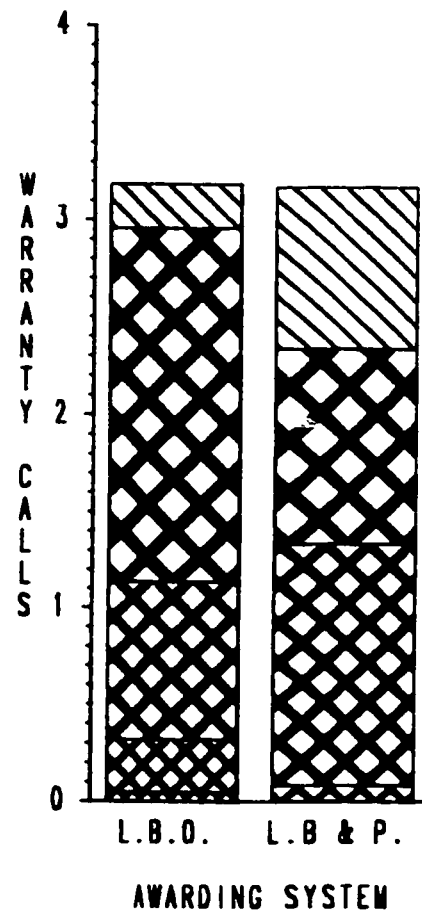


FIGURE NO 3.11 WARRANTY CALLS VS. BID AWARDING SYSTEM

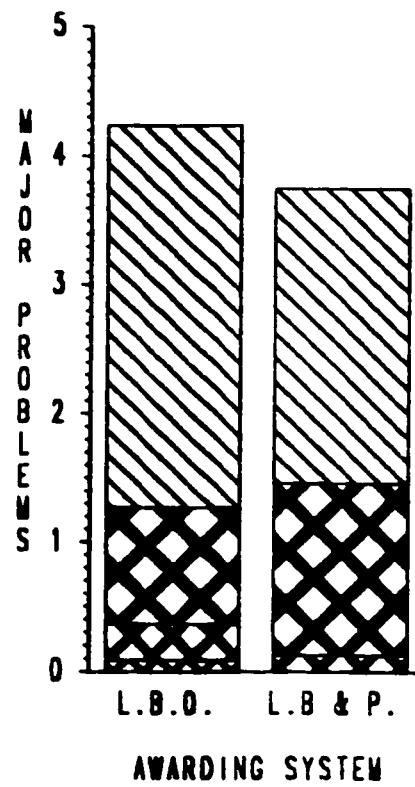


FIGURE NO 3.12 MAJOR PROBLEMS VS. BID AWARDING SYSTEM

different at 0.06 level of significance, which means that the average effect of (L.B.O.) contractor on project execution is very much higher than the effect of (L.B. & P.) contractors. This is true up to 94%. The two averages are graphically presented in Fig. 3.13.

3.5.3 *Evaluation of Projects Awarded to the Lowest Bidder as Government Practice only (L.B.O.) and Projects Awarded to the Lowest Bidder and Because the Bid was Close to Client's Estimates (L.B. & C.T.E)*

In Table (3.3), we give all statistical computations for testing H_0 against H_A in case of questions No. 8, 10, 11, 15, 16 and 17.

Some comments and results are given below.

3.5.3.1 Owner's Satisfaction:

The difference between the two averages is significantly different at 0.18 level of significance, which means that the average owner's satisfaction with the overall quality of work executed by (L.B. & C.T.E.) contractors is much better than those of (L.B.O.) contractors. This is true up to 82%. The two averages are graphically presented in Fig. 3.14.

3.5.3.2 Performance:

The difference between the two averages is significantly different at 0.13 level of significance. This means that the average performance of (L.B. & C.T.E.) contractors is much higher than the average performance of (L.B.O.) contractors, which is true up to 87%. The two averages are graphically presented in Fig. 3.15.

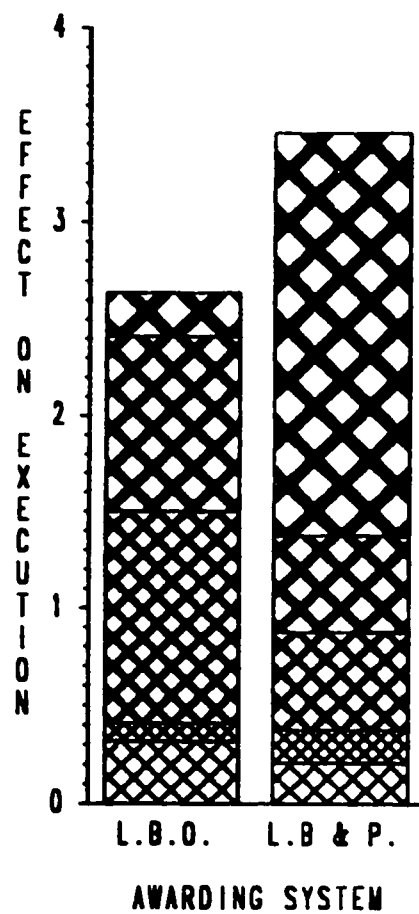


FIGURE NO 3.13 EFFECT ON PROJECT EXECUTION VS.BID AWARDING SYSTEM

Table 3.3: Evaluation of Projects Awarded to (L.B.O.)
vs. Projects Awarded to (L.B. & C.T.E.)

Variable	Awarding System	Number of Projects	Mean (Average)	Std. Dev.	Std. Error	T	DF	Prob.
(Q8) Owners Satisfaction	L.B. & C.T.E.	16	3.56250000	0.89209491	0.22302373	1.3658	36	0.1805
	L.B.O.	22	3.09090909	1.15094540	0.24538238			
(Q10) Performance of Contractor	L.B. & C.T.E.	16	3.29166667	0.817629982	0.20440745	1.5586	36	0.1278
	L.B.O.	22	2.81060606	1.01743460	0.21691779			
(Q11) Written Warnings issued to Contractor	L.B. & C.T.E.	16	3.81250000	1.10867789	0.27716947	0.9254	36	0.3609
	L.B.O.	22	3.45454545	1.22386090	0.26092802			
(Q15) Request to Attend Warranty Calls	L.B. & C.T.E.	16	3.62500000	1.20415946	0.30103986	1.1330	36	0.2647
	L.B.O.	22	3.18181818	1.18065211	0.25171587			
(Q16) Major Problems after Warranty Period	L.B. & C.T.E.	16	3.68750000	1.49303941	0.37325985	(-)1.2015	36	0.7626
	L.B.O.	22	4.22727273	1.26986382	0.27073588			
(Q17) Extent of Effect on Project Execution	L.B. & C.T.E.	16	3.18750000	0.98107084	0.24526771	1.4301	36	0.1613
	L.B.O.	22	2.63636364	1.29266998	0.27559817			

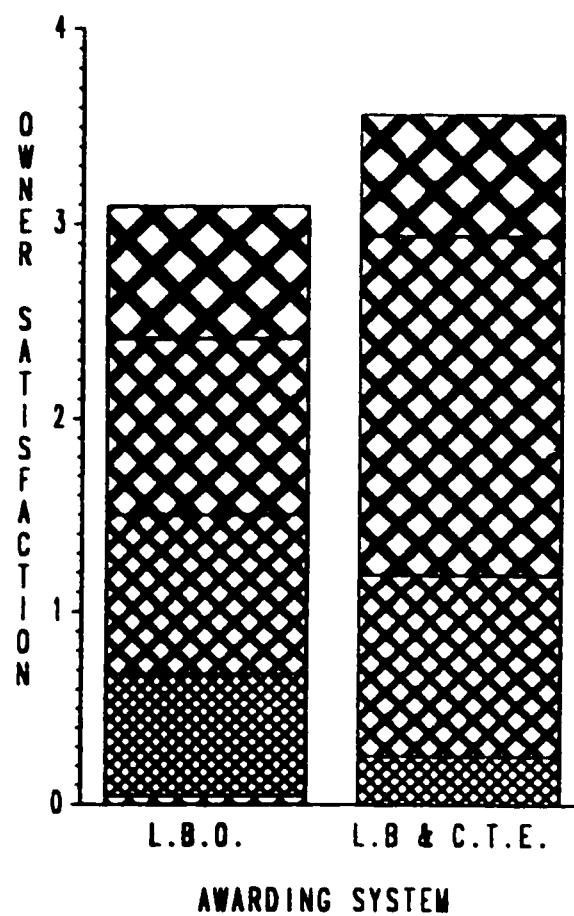


FIGURE NO 3.14 OWNER SATISFACTION VS.BID AWARDING SYSTEM

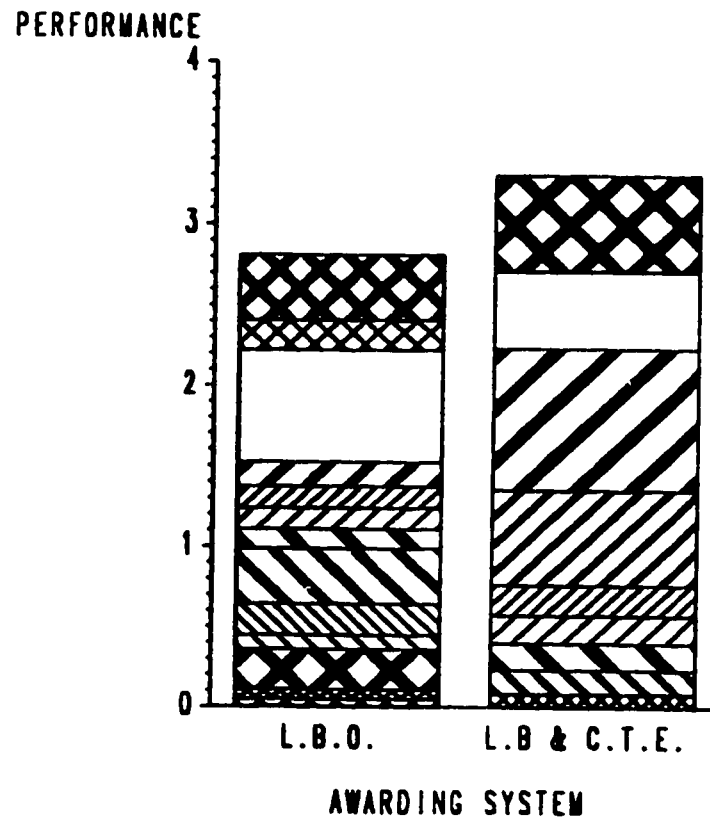


FIGURE NO 3.15 PERFORMANCE VS.BID AWARDING SYSTEM

3.5.3.3 Rate of Issuance of Written Warnings:

The difference between the two averages is significant at 0.36 level of significance. This means that the average number of written warnings received by (L.B.O.) contractors is higher than the average of (L.B. & C.T.E.) contractors. This is true up to 64%. The two averages are graphically presented in Fig. 3.16.

3.5.3.4 Rate of Requests to Attend Warranty Calls:

The difference between the two averages is significant at 0.26 level of significance. This means that the average number of requests to attend warranty calls during the warranty period for (L.B. & C.T.E.) contractors is less than the average number of requests for (L.B.O.) contractors, who received more warranty calls. This is true up to 74%. The two averages are graphically presented in Fig. 3.17.

3.5.3.5 Rate of Facing Major Problems After Warranty Period:

The average number of major problems which have been faced after the warranty period in projects awarded to (L.B.O.) contractors is more than the average number for (L.B. & C.T.E.) contractors, which means that the (L.B. & C.T.E.) contractors cause more major problems than (L.B.O.) contractors after the warranty period. The two averages are graphically presented in Fig. 3.18.

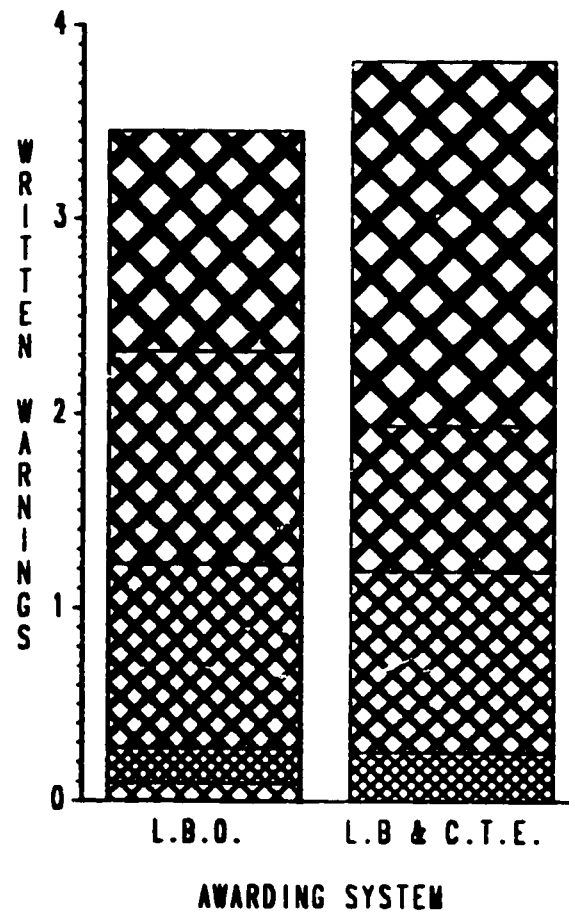


FIGURE NO 3.16 WRITTEN WARNINGS VS. BID AWARDING SYSTEM

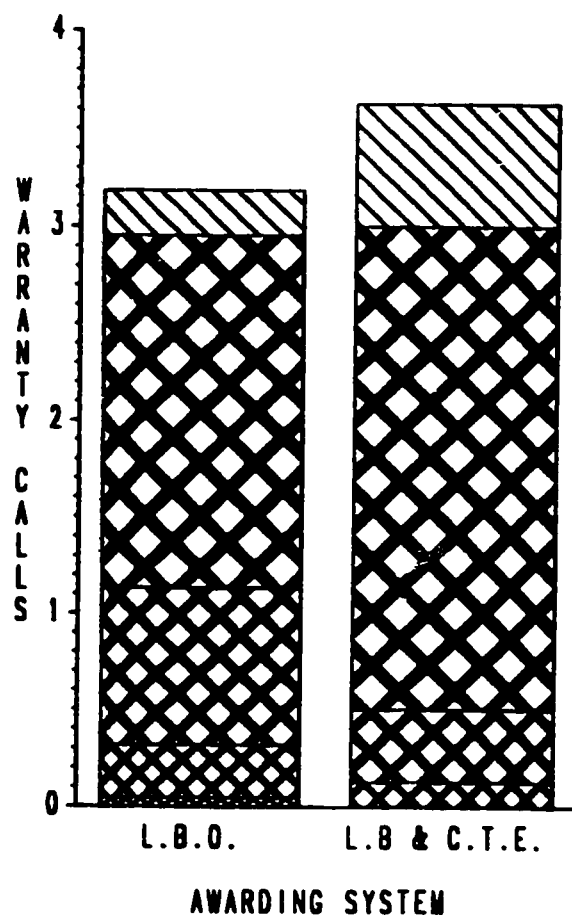


FIGURE NO 3.17 WARRANTY CALLS VS. BID AWARDING SYSTEM

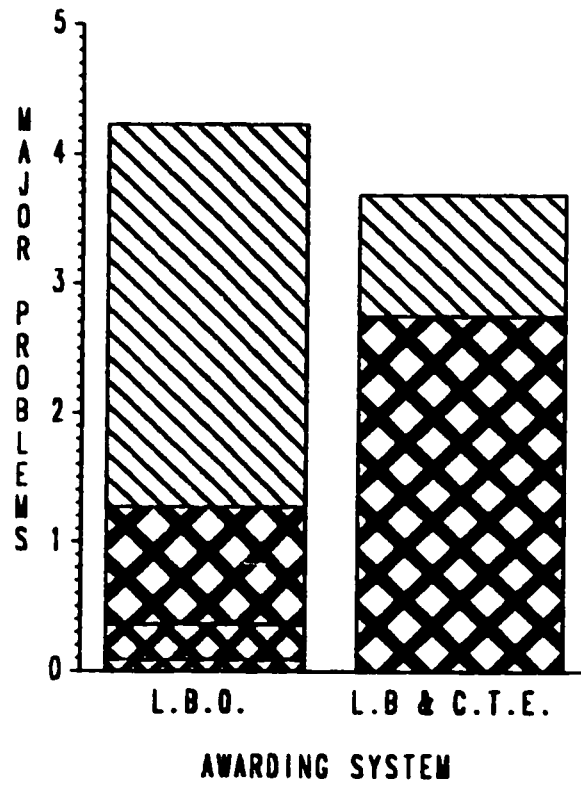


FIGURE NO 3.18 MAJOR PROBLEMS VS. BID AWARDING SYSTEM

3.5.3.6 Extent of Effect on Project Execution:

The difference between the two averages is significant at 0.16 level of significance. This means that the effect of (L.B. & C.T.E.) contractors on projects execution is much less than the effect of (L.B.O.) contractors. This is true up to 84%. The two averages are graphically presented in Fig. 3.19.

3.5.4 *Evaluation of Projects Awarded to the Lowest Bidder as Government Practice only (L.B.O.), and Projects Awarded to the Lowest Bidder and Because his Bid was Reasonable and Competitive (L.B. & R.C.)*

In Table (3.4), we give all statistical computations for testing H_0 against H_A in case of questions No. 8, 10, 11, 15, 16 and 17. Some comments and results are given below.

3.5.4.1 Owner's Satisfaction:

The difference between the two averages is most significant at 0.03 level of significance, which means that the average owner's satisfaction with the overall quality of work executed by (L.B. & R.C.) contractors is very much higher than that for (L.B.O.) contractors. This is true up to 97%. The two averages are graphically represented in Fig. 3.20.

3.5.4.2 Performance:

The difference between the two averages is highly significant at 0.03 level of significance. This means that the average performance of (L.B. & R.C.) contractors is much higher than the average

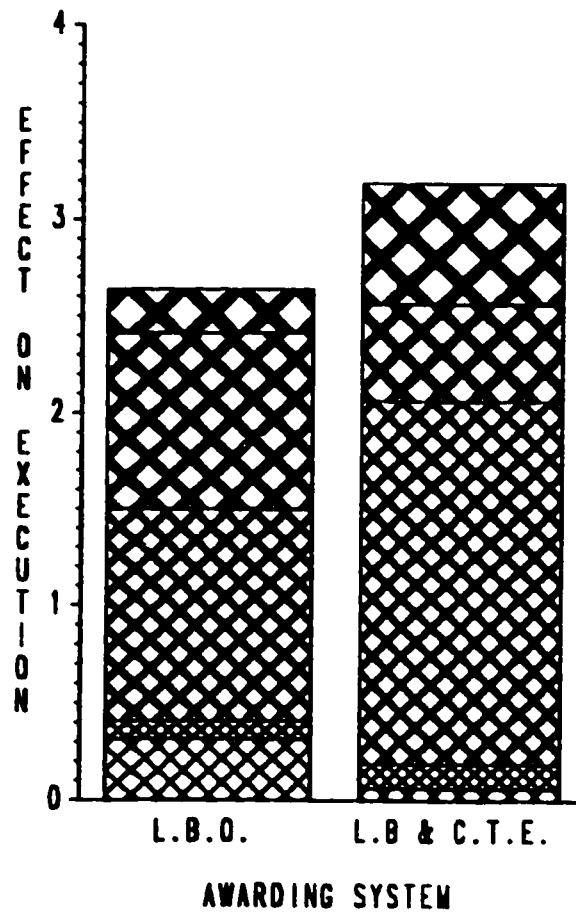


FIGURE NO 3.19 EFFECT ON PROJECT EXECUTION VS.BID AWARDING SYSTEM

**Table 3.4: Evaluation of Projects Awarded to (L.B.O.)
vs. Projects Awarded to (L.B. & R.C.)**

Variable	Awarding System	Number of Projects	Mean (Average)	Std. Dev.	Std. Error	T	DF	Prob.
(Q8) Owners Satisfaction	L.B.& R.C.	23	3.78260870	0.95138759	0.19837803	2.2015	43	0.0331
	L.B.O.	22	3.09090909	1.15094540	0.24538238			
(Q10) Performance of Contractor	L.B.& R.C.	23	3.50724638	1.02059383	0.21280852	2.2924	43	0.0268
	L.B.O.	22	2.81060606	1.01743460	0.21691779			
(Q11) Written Warnings issued to Contractor	L.B.& R.C.	23	4.17391304	1.02921744	0.21460667	2.1376	43	0.0383
	L.B.O.	22	3.45454545	1.22386090	0.26092802			
(Q15) Request to Attend Warranty Calls	L.B.& R.C.	23	3.52173913	1.12288448	0.23413760	0.9899	43	0.3278
	L.B.O.	22	3.18181818	1.18065211	0.25171587			
(Q16) Major Problems after Warranty Period	L.B.& R.C.	23	4.21739130	1.12639900	0.23487043	(-)0.0276	43	0.9781
	L.B.O.	22	4.22727273	1.26986382	0.27073588			
(Q17) Extent of Effect on Project Execution	L.B.& R.C.	23	3.43478261	1.50230390	0.31325202	1.9071	43	0.0632
	L.B.O.	22	2.63636364	1.29266998	0.27559817			

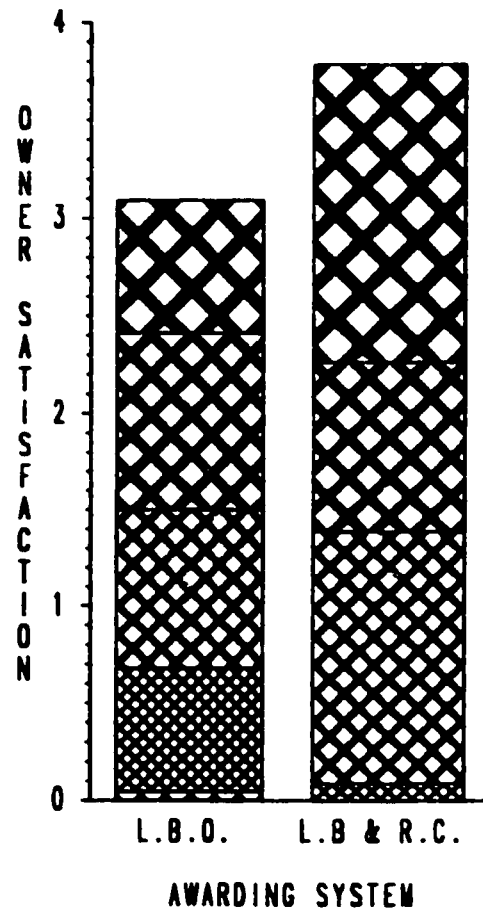


FIGURE NO 3.20 OWNER SATISFACTION VS.BID AWARDING SYSTEM

performance of (L.B.O.) contractors. This is true up to 97%. The two averages are graphically presented in Fig. 3.21.

3.5.4.3 Rate of Issuance of Written Warnings:

The difference between the two averages is highly significant different at 0.04 level of significance. This means that the average rate of (L.B. & R.C.) contractors being issued written warnings is very much less than in the case of (L.B.O.) contractors. This is true up to 96%. The two averages are graphically presented in Fig. 3.22.

3.5.4.4 Rate of Requests to Attend Warranty Calls:

The difference between the two averages is significant at 0.33 level of significance, which means that the rate of requests to attend warranty calls during the warranty period for (L.B. & R.C.) contractors is less than the rate for (L.B.O.) contractors. This is true up to 67%. The two averages are graphically presented in Fig. 3.23.

3.5.4.5 Rate of Facing Major Problems After Warranty Period:

The average number of major problems which have been faced after the warranty period in projects awarded to (L.B.O.) contractors is almost equal to the average number for (L.B. & R.C.) contractors. The two averages are graphically presented in Fig. 3.24.

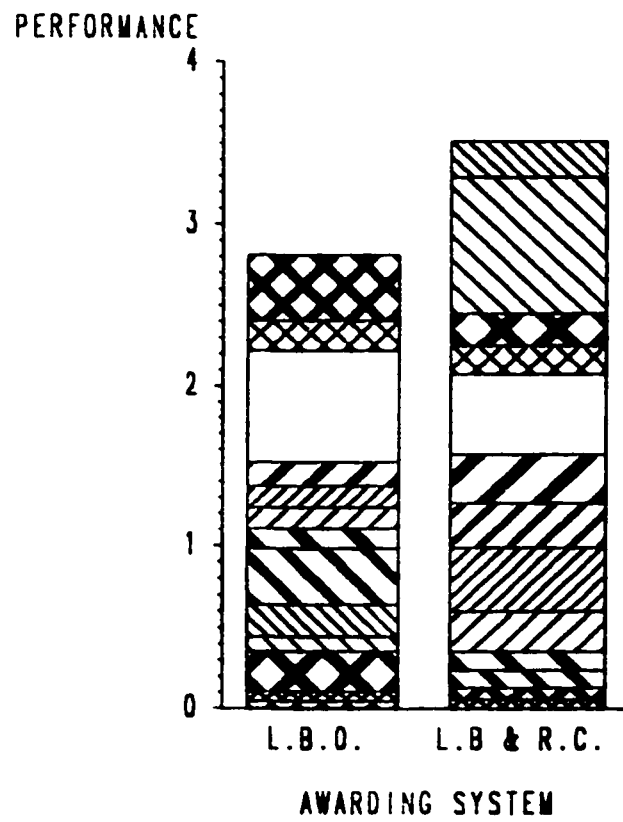


FIGURE NO 3.21 PERFORMANCE VS. BID AWARDING SYSTEM

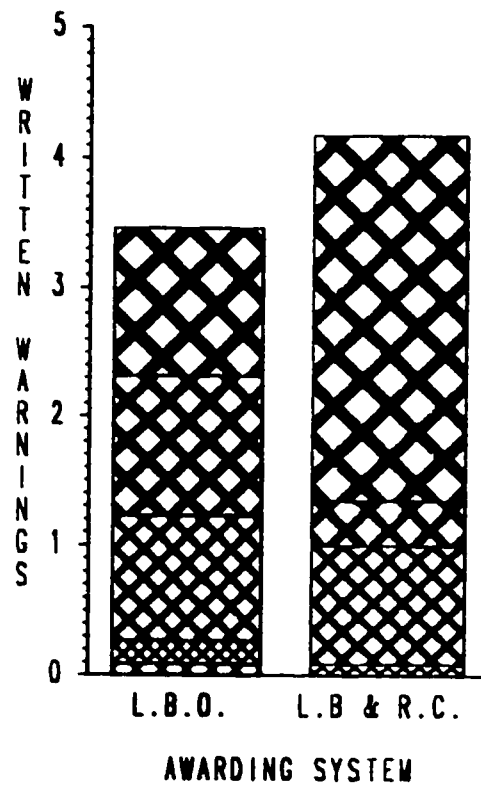


FIGURE NO 3.22 WRITTEN WARNINGS VS. BID AWARDING SYSTEM

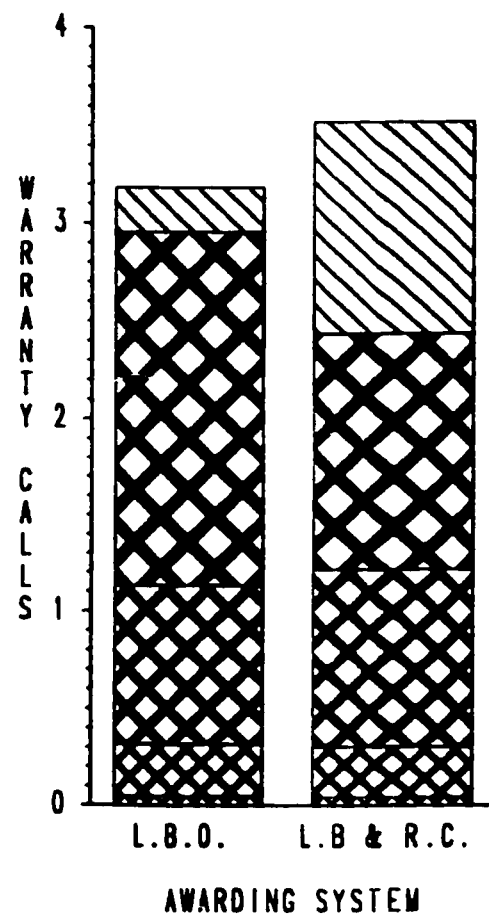


FIGURE NO 3.23 WARRANTY CALLS VS. BID AWARDING SYSTEM

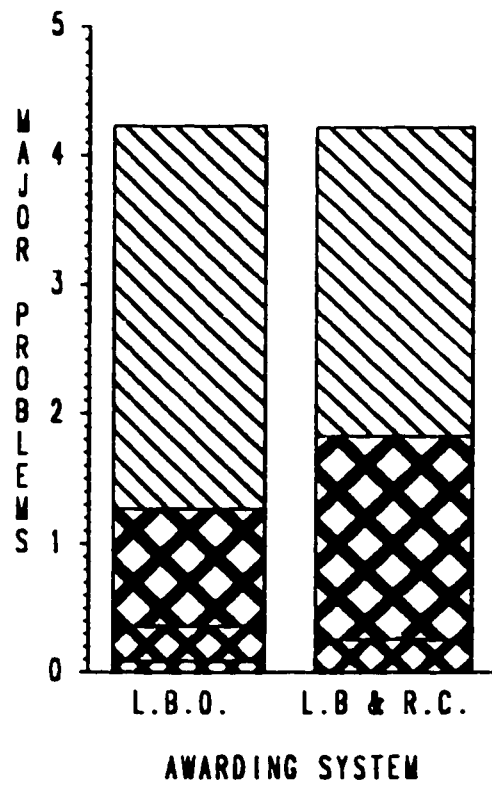


FIGURE NO 3.24 MAJOR PROBLEMS VS. BID AWARDING SYSTEM

3.5.4.6 Extent of Effect on Project Execution:

The difference between the two averages is highly significant at 0.06 level of significance, which means that the effect of (L.B. & R.C.) contractors on project execution is very much less than the effect of (L.B.O.) contractors. This is true up to 94%. The two averages are graphically presented in Fig. 3.25.

3.5.5 *Evaluation of Projects Awarded to the Lowest Bidder as Government Practice only (L.B.O.), and Projects Awarded to the Lowest Bidder Because his Bid was the Most Competent (L.B. & M.C.)*

In Table (3.5), we give all statistical computations for testing H_0 against H_A in case of questions No. 8, 10, 11, 15, 16 and 17. Some comments and results are given below.

3.5.5.1 Owner's Satisfaction:

The difference between the two averages is highly significant at 0.0005 level of significance which means that the average owner's satisfaction with the overall quality of work executed by (L.B. & M.C.) contractors is very much higher than for (L.B.O.) contractors. This is true up to 99.95%. The two averages are graphically presented in Fig. 3.26.

3.5.5.2 Performance:

The difference between the two averages is highly significant at 0.002 level of significance, which means that the average performance of (L.B. & M.C.) contractors is very much higher than the

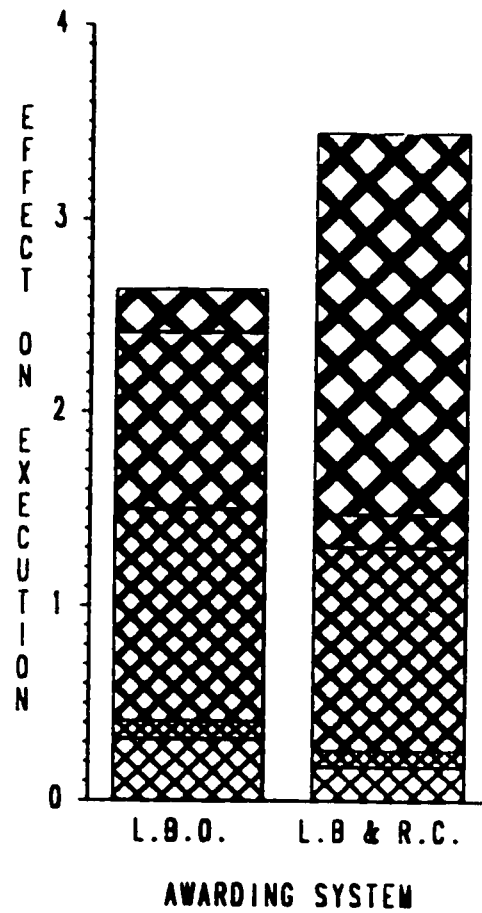


FIGURE NO 3.25 EFFECT ON PROJECT EXECUTION VS.BID AWARDING SYSTEM

Table 3.5: Evaluation of Projects Awarded to (L.B.O.)
vs. Projects Awarded to (L.B. & M.C.).

Variable	Awarding System	Number of Projects	Mean (Average)	Std. Dev.	Std. Error	T	DF	Prob.
(Q8) Owners Satisfaction	L.B. & M.C.	12	4.50000000	0.67419986	0.19462474	3.8772	32	0.0005
	L.B.O.	22	3.09090909	1.15094540	0.24538238			
(Q10) Performance of Contractor	L.B. & M.C.	12	4.02777778	1.00712947	0.29073323	3.3452	32	0.0021
	L.B.O.	22	2.81060606	1.01743460	0.21691779			
(Q11) Written Warnings issued to Contractor	L.B. & M.C.	12	4.75000000	0.62158156	0.17943514	3.4174	32	0.0017
	L.B.O.	22	3.45454545	1.22386090	0.26092802			
(Q15) Request to Attend Warranty Calls	L.B. & M.C.	12	3.83333333	1.83484711	0.24099960	1.6897	32	0.1008
	L.B.O.	22	3.18181818	1.18065211	0.25171587			
(Q16) Major Problems after Warranty Period	L.B. & M.C.	12	4.91666667	0.28867513	0.08333333	1.8426	32	0.0747
	L.B.O.	22	4.22727273	1.26986382	0.27073588			
(Q17) Extent of Effect on Project Execution	L.B. & M.C.	12	4.16666667	1.33711585	0.38599210	3.2598	32	0.0027
	L.B.O.	22	2.63636364	1.29266998	0.26559817			

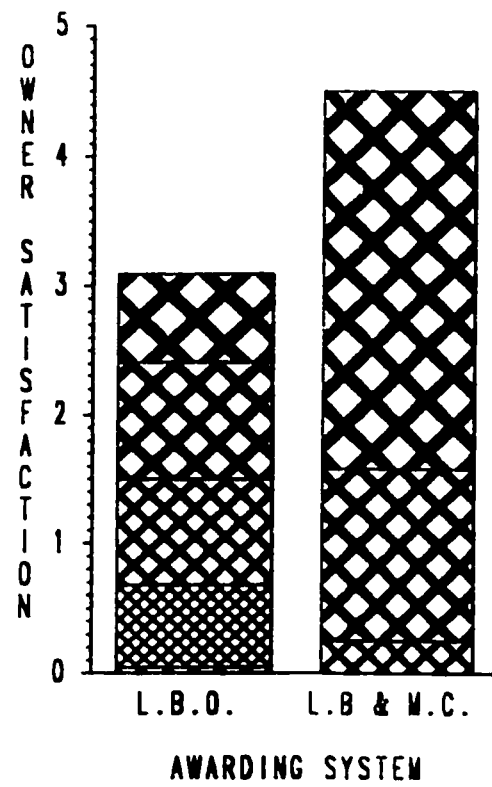


FIGURE NO 3.26 OWNER SATISFACTION VS.BID AWARDING SYSTEM

average performance of (L.B.O.) contractors. This is true up to 99.8%. The two averages are graphically presented in Fig. 3.27.

3.5.5.3 Rate of Issuance of Written Warnings:

The difference between the two averages is highly significant at 0.002 level of significance which means that the rate of (L.B. & M.C.) contractors' being issued written warnings is very much less than in the case of (L.B.O.) contractors. This is true up to 99.8%. The two averages are graphically presented in Fig. 3.28.

3.5.5.4 Rate of Requests to Attend Warranty Calls:

The difference between the two averages is highly significant at 0.10 level of significance which means that the rate of requests to attend warranty calls during the warranty period for (L.B. & M.C.) contractors is much less than the average number for (L.B.O.) contractors. This is true up to 90%. The two averages are graphically presented in Fig. 3.29.

3.5.5.5 Rate of Facing Major Problems After Warranty Period:

The difference between the two averages is significant at 0.07 level of significance, which means that the rate of major problems which have been faced after the warranty period in projects awarded to (L.B. & M.C.) contractors is much less than for those awarded to (L.B.O.) contractors. This is true up to 93%. The two averages are graphically presented in Fig. 3.30.

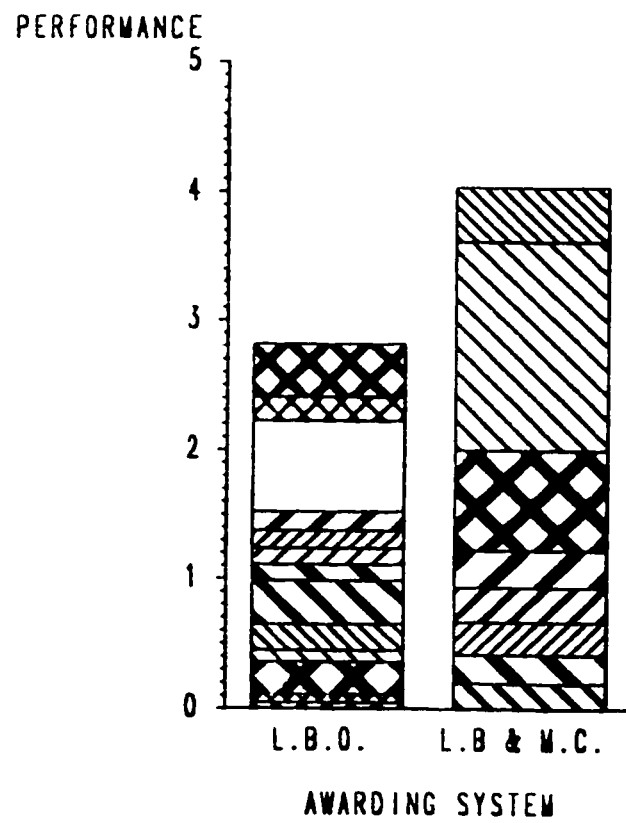


FIGURE NO 3.27 PERFORMANCE VS. BID AWARDING SYSTEM

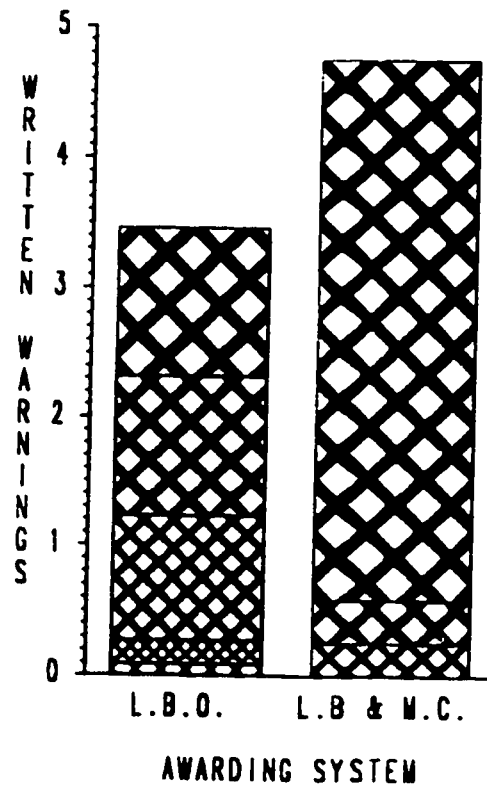


FIGURE NO 3.28 WRITTEN WARNINGS VS. BID AWARDING SYSTEM

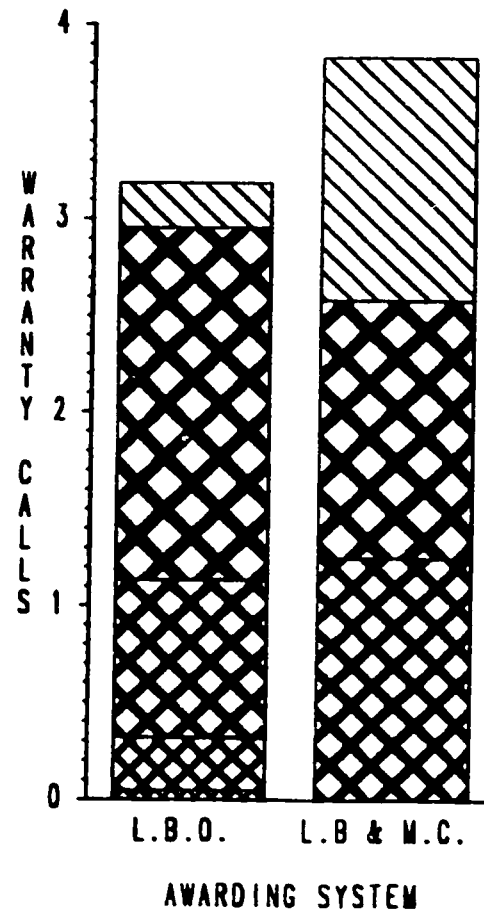


FIGURE NO 3.29 WARRANTY CALLS VS. BID AWARDING SYSTEM

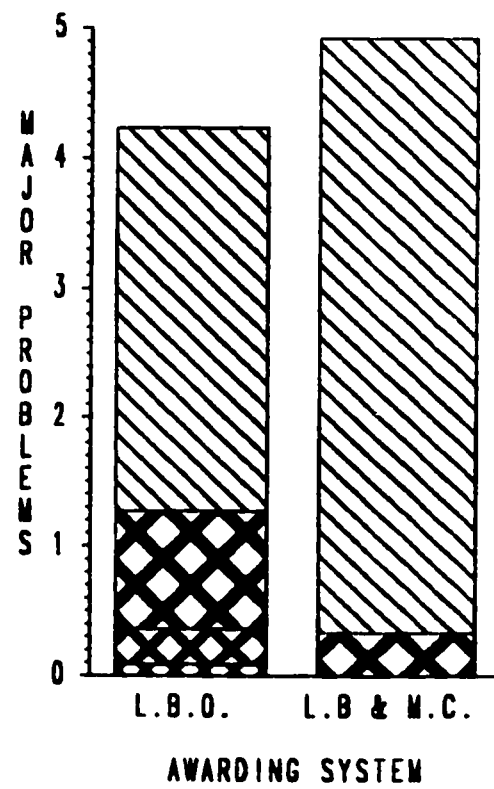


FIGURE NO 3.30 MAJOR PROBLEMS VS. BID AWARDING SYSTEM

3.5.5.6 Extent of Effect on Project Execution:

The difference between the two averages is highly significant at 0.0003 level of significance, which means that the effect of (L.B. & M.C.) contractors on project execution is very much less than the effect of (L.B.O.) contractors. This is true up to 99.7%. The two averages are graphically presented in Fig. 3.31.

3.5.6 *Evaluation of Projects Awarded to the Lowest Bidder as Government Practice only (L.B.O.), and Projects Awarded to the Lowest Bidder and Because the Client has had good Experience with him (L.B. & G.E.)*

In Table (3.6), we give all statistical computations for testing H_0 against H_A in case of questions No. 8, 10, 11, 15, 16 and 17.

Some comments and results are given below.

3.5.6.1 Owner's Satisfaction:

The difference between the two averages is highly significant at 0.001 level of significance which means that the average owner's satisfaction with the overall quality of work executed by (L.B. & G.E.) contractors is very much higher than for (L.B.O.) contractors. This is true up to 99.90%. The two averages are graphically presented in Fig. 3.32.

3.5.6.2 Performance:

The difference between the two averages is highly significant at 0.005 level of significance, which means that the average

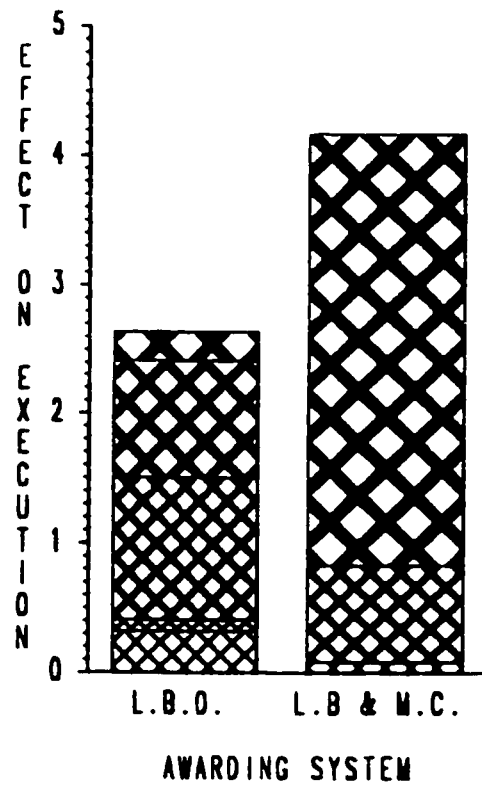


FIGURE NO 3.31 EFFECT ON PROJECT EXECUTION VS.BID AWARDING SYSTEM

Table 3.6: Evaluation of Projects Awarded to (L.B.O.)
vs. Projects Awarded to (L.B. & G.E.).

Variable	Awarding System	Number of Projects	Mean (Average)	Std. Dev.	Std. Error	T	DF	Prob.
(Q8) Owners Satisfaction	L.B. & G.E.	14	4.35714286	0.74494634	0.19909528	3.6487	34	0.0009
	L.B.O.	22	3.09090909	1.15094540	0.24533838			
(Q10) Performance of Contractor	L.B. & G.E.	14	3.90476190	1.12035229	0.29942674	3.0250	34	0.0047
	L.B.O.	22	2.81060606	1.01743460	0.21691779			
(Q11) Written Warnings issued to Contractor	L.B. & G.E.	14	4.57142857	0.93761446	0.25058801	2.9089	34	0.0064
	L.B.O.	22	3.45454545	1.22386090	0.26092802			
(Q15) Request to Attend Warranty Calls	L.B. & G.E.	14	3.71428571	0.91387353	0.24424298	1.4336	34	0.1608
	L.B.O.	22	3.18181818	1.18065211	0.25171587			
(Q16) Major Problems after Warranty Period	L.B. & G.E.	14	3.78571429	0.57893422	0.15472668	1.5406	34	0.1327
	L.B.O.	22	4.22727273	1.26986382	0.27073588			
(Q17) Extent of Effect on Project Execution	L.B. & G.E.	14	3.71428571	1.68379477	0.45001308	2.1674	34	0.0373
	L.B.O.	22	2.63636364	1.29266998	0.27559817			

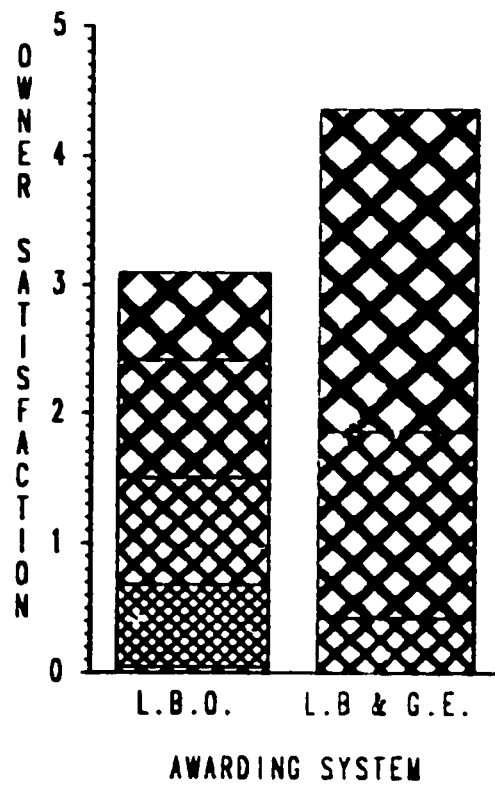


FIGURE NO 3.32 OWNER SATISFACTION VS.BID AWARDING SYSTEM

performance of (L.B. & G.E.) contractors is very much higher than the average performance of (L.B.O.) contractors. This is true up to 99.55%. The two averages are graphically presented in Fig. 3.33.

3.5.6.3 Rate of Issuance of Written Warnings:

The difference between the two averages is highly significant at 0.006 level of significance which means that the rate of (L.B. & G.E.) contractors' being issued written warnings is very much less than in the case of (L.B.O.) contractors. This is true up to 99.4%. The two averages are graphically presented in Fig. 3.34.

3.5.6.4 Rate of Requests to Attend Warranty Calls:

The difference between the two averages is highly significant at 0.16 level of significance which means that the rate of requests to attend warranty calls during the warranty period for (L.B. & G.E.) contractors is much less than the rate of requests for (L.B.O.) contractors. This is true up to 84%. The two averages are graphically presented in Fig. 3.35.

3.5.6.5 Rate of Facing Major Problems After Warranty Period:

The difference between the two averages is significant at 0.13 level of significance, which means that the rate of major problems which have been faced after the warranty period in projects awarded to (L.B. & G.E.) contractors is much less than for those awarded to (L.B.O.) contractors. This is true up to 87%. The two averages

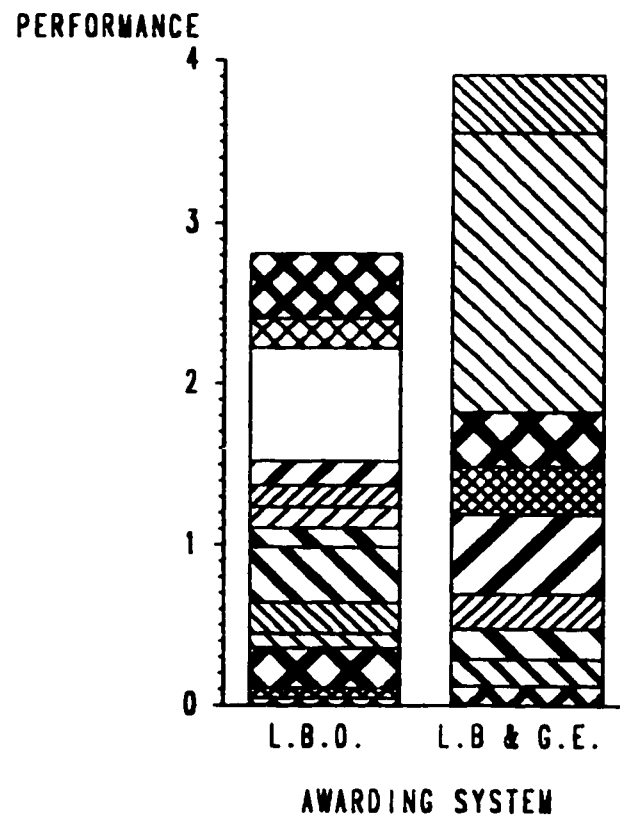


FIGURE NO 3.33 PERFORMANCE VS.BID AWARDING SYSTEM

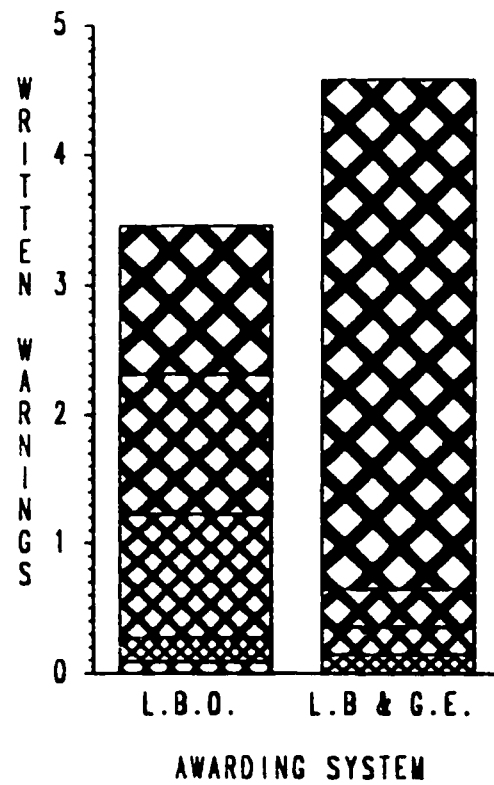


FIGURE NO 3.34 WRITTEN WARNINGS VS. BID AWARDING SYSTEM

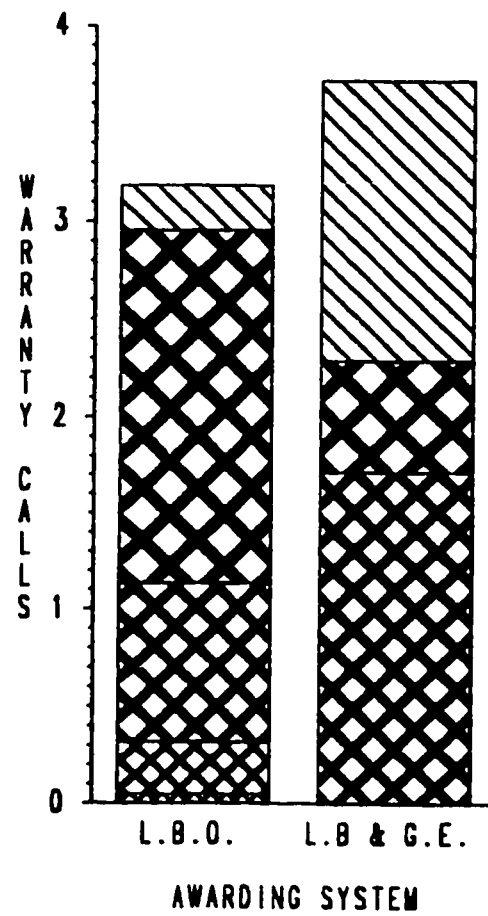


FIGURE NO 3.35 WARRANTY CALLS VS. BID AWARDING SYSTEM

are graphically presented in Fig. 3.36.

3.5.6.6 Extent of Effect on Project Execution:

The difference between the two averages is highly significant at 0.04 level of significance, which means that the effect of (L.B. & G.E.) contractors on project execution is very much less than the effect of (L.B.O.) contractors. This is true up to 96%. The two averages are graphically presented in Fig. 3.37.

3.5.7 *Evaluation of Projects Awarded to the Lowest Bidder as Government Practice only (L.B.O.), and Projects Awarded to the Lowest Bidder and Because he was Classified (L.B. & C.)*

In Table (3.7), we give all statistical computations for testing H_0 against H_A in case of questions No. 8, 10, 11, 15, 16 and 17.

Some comments and results are given below.

3.5.7.1 Owner's Satisfaction:

The difference between the two averages is highly significant at 0.14 level of significance which means that the average owner's satisfaction with the overall quality of work executed by (L.B. & C.) contractors is much higher than in the case of (L.B.O.) contractors. This is true up to 86%. The two averages are graphically presented in Fig. 3.38.

3.5.7.2 Performance:

The difference between the two averages is highly significant

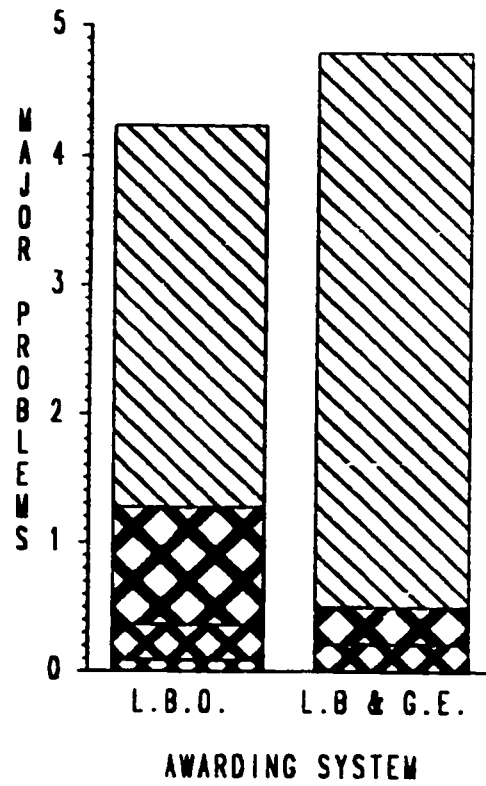


FIGURE NO 3.36 MAJOR PROBLEMS VS. BID AWARDING SYSTEM

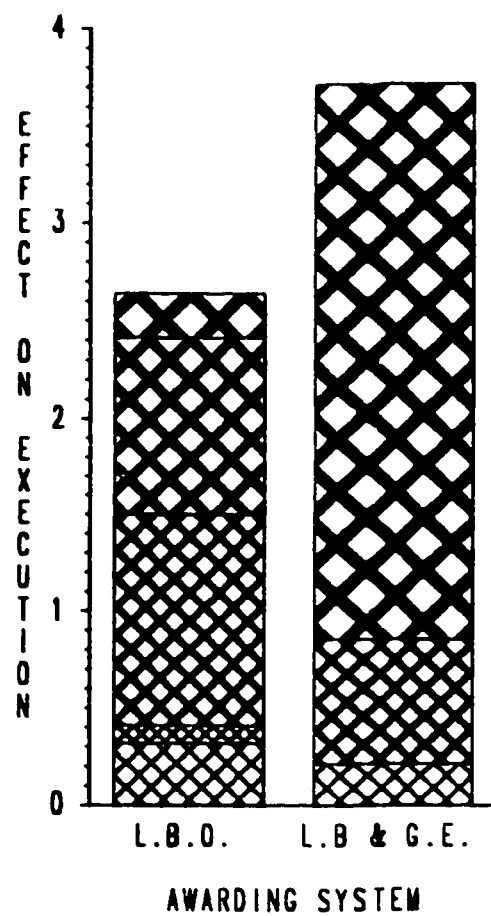


FIGURE NO 3.37 EFFECT ON PROJECT EXECUTION VS.BID AWARDING SYSTEM

Table 3.7: Evaluation of Projects Awarded to L.B.O.)
vs. Projects Awarded to (L.B. & C.).

Variable	Awarding System	Number of Projects	Mean (Average)	Std. Dev.	Std. Error	T	DF	Prob.
(Q8) Owners Satisfaction	L.B.& C.	93	3.46236559	1.02744025	0.10654059	1.4901	113	0.1390
	L.B.O.	22	3.09090909	1.15094540	0.24538238			
(Q10) Performance of Contractor	L.B.& C.	93	3.04480287	1.09128624	0.11316111	0.9164	113	0.3614
	L.B.O.	22	2.81060606	1.01743460	0.21691779			
(Q11) Written Warnings issued to Contractor	L.B.& C.	93	3.90322581	1.19840942	0.12426927	1.5729	113	0.1185
	L.B.O.	22	3.45454545	1.22386090	0.26092802			
(Q15) Request to Attend Warranty Calls	L.B.& C.	93	3.02150538	1.31031439	0.13587327	(-)0.5253	113	0.3996
	L.B.O.	22	3.18181818	1.18065211	0.25171587			
(Q16) Major Problems after Warranty Period	L.B.& C.	93	3.20430108	2.01386034	0.20882759	(-)2.2736	113	0.9751
	L.B.O.	22	4.22727273	1.26866382	0.27073588			
(Q17) Extent of Effect on Project Execution	L.B.& C.	93	2.29032258	1.55046028	0.16077524	(-)0.9693	113	0.6655
	L.B.O.	22	2.67636364	1.29266998	0.27559817			

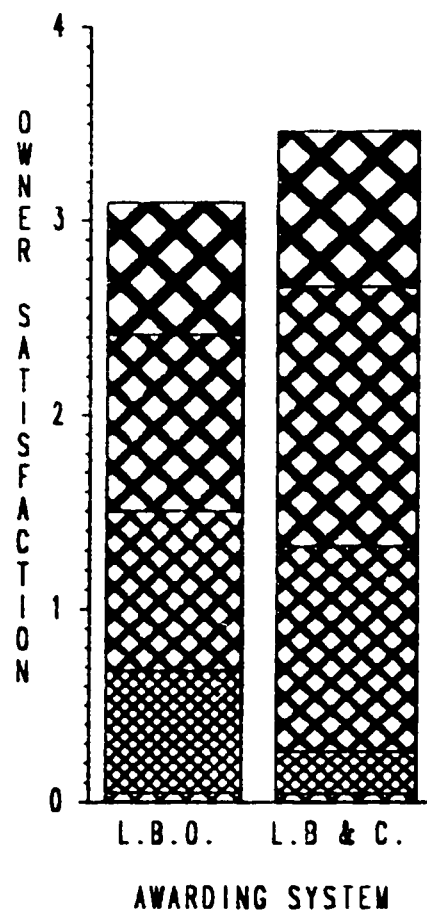


FIGURE NO 3.38 OWNER SATISFACTION VS.BID AWARDING SYSTEM

at 0.36 level of significance, which means that the average performance of (L.B. & C.) contractors is very much higher than the average performance of (L.B.O.) contractors. This is true up to 64%. The two averages are graphically presented in Fig. 3.39.

3.5.7.3 Rate of Issuance of Written Warnings:

The difference between the two averages is highly significant at 0.12 level of significance, which means that the rate of (L.B. & C.) contractors' being issued written warnings is very much less than in the case for (L.B.O.) contractors. This is true up to 88%. The two averages are graphically presented in Fig. 3.40.

3.5.7.4 Rate of Requests to Attend Warranty Calls:

The Average number of requests to attend warranty calls during the warranty period for (L.B.O.) contractors is more than the average number for (L.B. & C.) contractors, which means that more calls have been received by (L.B. & C.) contractors than (L.B.O.) contractors. The two averages are graphically presented in Fig. 3.41.

3.5.7.5 Rate of Facing Major Problems After Warranty Period:

The average number of major problems which have been faced after the warranty period in projects awarded to (L.B.O.) contracts is more than the average for (L.B. & C.) contractors, which means that the (L.B. & C.) contractors caused more major problems after

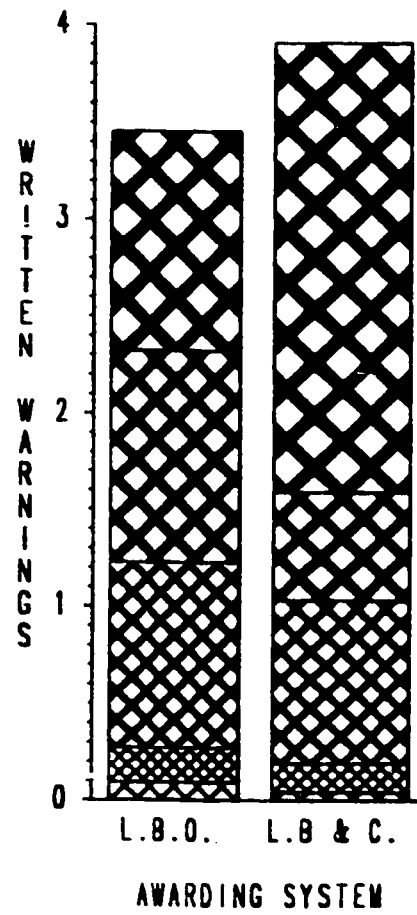


FIGURE NO 3.40 WRITTEN WARNINGS VS. BID AWARDING SYSTEM

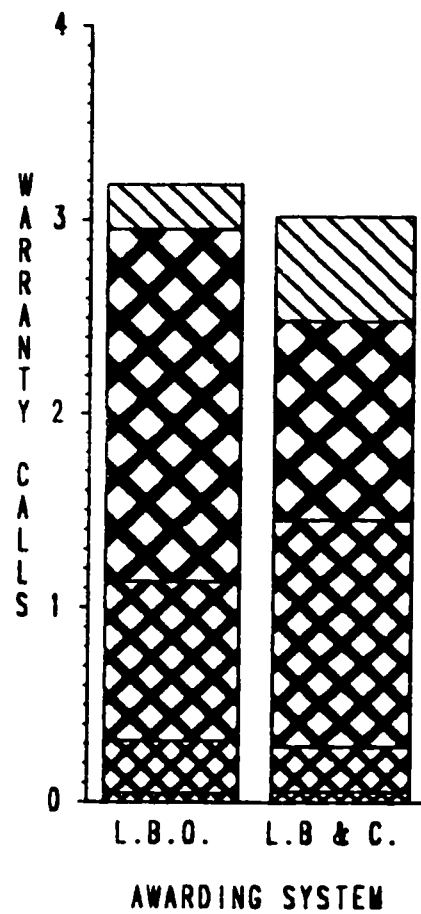


FIGURE NO 3.41 WARRANTY CALLS VS. BID AWARDING SYSTEM

the warranty period than the (L.B.O.) contractors. The two averages are graphically presented in Fig. 3.42.

3.5.7.6 Extent of Effect on Project Execution:

The average effect of (L.B.O.) contractors on project execution is more than the average effect of (L.B. & C.) contractors. In other words, the (L.B. & C.) contractors affected the execution of projects awarded to them more than (L.B.O.) contractors. The two averages are graphically presented in Fig. 3.43.

3.6 Respondents' Suggestions

As mentioned in Section 3.2, Question 13 was put to give the interviewer the chance to express what he feels required to improve the lowest bidder bid awarding system. The following are their suggestions for improvements:

- 1) Prequalification of contractors should be carried out first and only the qualified ones are invited to submit their offers.
- 2) Bids should be closer to department estimates.
- 3) In the case of contractor defaults, the imposition of risk and cost clauses should be applicable without complications.
- 4) Classification should be strictly adhered to.
- 5) Sufficient back guarantees should be taken.
- 6) If the lowest bid is higher than the estimated cost and the

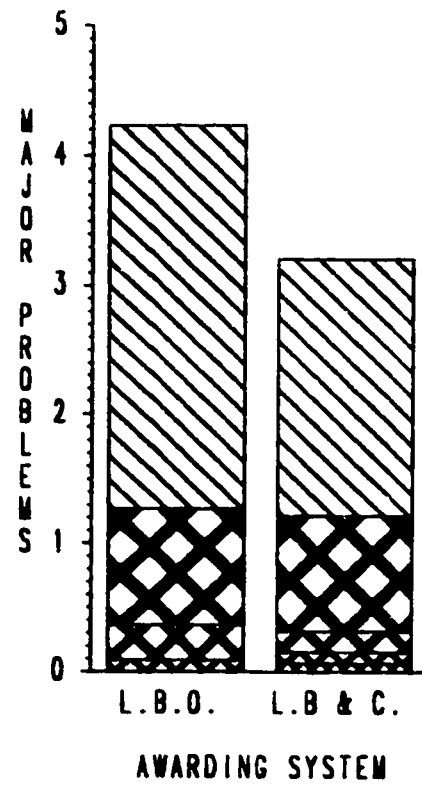


FIGURE NO 3.42 MAJOR PROBLEMS VS. BID AWARDING SYSTEM

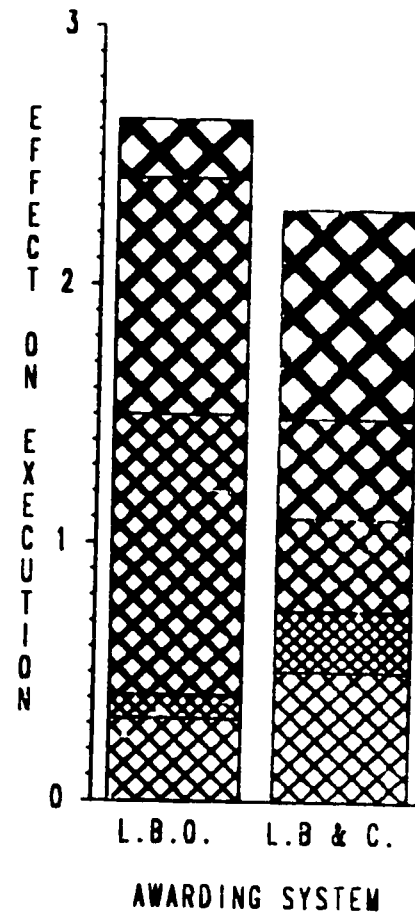


FIGURE NO 3.43 EFFECT ON PROJECT EXECUTION VS.BID AWARDING SYSTEM

bidder is not qualified to do the job, the second lowest should be considered if his price is reasonable.

- 7) The three lowest bidders within a range of difference of SR. 200,000 should be re-evaluated and their prequalification for the job should be reassessed. The contract should be awarded to the more competent bidder irrespective of the cost.
- 8) The nearest offer to the estimate or the one nearest to the average of all participants' offers should be chosen.
- 9) It should be ensured that the bid presents the lowest actual cost of the project.
- 10) Prequalification of bidders should cover past experience, financial position, equipment, manpower, impression of previous clients, field visits and organization.
- 11) Contractors' specializations should be considered.
- 12) Contractors should be capable and have had good experience.
- 13) All documents issued from the owner should be complete and clear.
- 14) Classification certificates should be requested by owners.
- 15) All offers which are 10% or less than the estimated cost should be excluded.
- 16) The owner should not be required to select the lowest offer and should be authorized to accept or reject any offer without mentioning any reasons.

- 17) An offer which is lower than the estimated cost should be analyzed item by item and the type of material to be used should be negotiated.
- 18) There should be a serious discussion with contractors to be sure that they have studied the job well and understood it.
- 19) Multiple sites should not be given to the same contractor.
- 20) The contract should be awarded to the bidder nearest to the average cost which is calculated as follows:

$$\text{Average Cost} = \frac{\text{Estimated Cost} + (\text{Lowest Cost} + \text{Second Lowest} + \text{Third Lowest})}{3}$$

$$\frac{\quad}{2}$$

- 21) Minimum and maximum cost estimates should be considered when selecting the successful bidder.

Chapter 4

SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND FURTHER STUDIES NEEDED

4.1 Summary

A performance study of the lowest bidder bid awarding system in Government projects, has been discussed and analyzed throughout this research.

Chapter 1 introduced the objectives of this research and previous studies about the lowest bidder bid awarding system. Although some studies have been done in such fields, there are, to the best of the author's knowledge, very few studies about the performance of the lowest bidder system worldwide and almost no studies at all have been done about the awarding stage of construction. It was concluded that there is a need to study the performance of projects awarded to bidders as they offer the lowest bid price in order to serve as a basic research to help in establishing more detailed research in the future. At the end of Chapter 1, the available bid awarding systems were identified in order to discuss them in the following chapter. They are the 'lowest bidder systems', 'nearest to the average of all bids received', 'limited by average bid' and 'owner's estimate', 'Danish system', 'German system' and 'negotiated offer'.

Chapter 2 discussed the Available Bid Awarding System and how each system works and how can it be applied. Also the system practiced in Saudi Arabia for awarding of contracts was explained.

Chapter 3 discussed the results of the survey, which disclosed how the eight formed groups for comparison were performed during and after the construction process. At the end of this chapter, the respondents' suggestions for improving the lowest bidder bid awarding system were listed.

Chapter 4 contains the summary, conclusion and recommendations for further studies. In this chapter, the author summarizes each of the four chapters. The groups of comparison have been ranked according to their means (averages), and categorized on the basis of level of significance. A number of important recommendations were listed after conclusion. Finally further studies were suggested to be done in the future.

Appendix A presents the final form of the questionnaire, Appendix B presents the computer program used to analyze the questionnaire. It also contains the computer analysis of different statistical data and results.

4.2 Conclusion

Based on the discussions and different analysis in the previous chapters, a number of conclusions seem to be warranted.

From the first two chapters, it was clear that the lowest bidder bid awarding system is the prevalent system used to award public projects under open competitive tendering.

From the first two chapters, it was clear that the awarding stage is the most critical stage in the construction process. The lowest bidder bid awarding system is the prevalent bid awarding system used to award public projects under open competitive tendering in most countries in general and in Saudi Arabia in particular. There has not been enough basic research done in such an important field.

The different awarding systems discussed in Chapter 2 indicate how owners differ in their awareness of the lowest bidder problem, Whereas some of them reject the system completely, others still believe in its validity.

The third chapter deals with projects awarded to the lowest bidder as government practice only with no other requirements: Tables 4.1 and 4.2.

Results showed:

- The lowest average owner's satisfaction among all the groups with level of significance ranges between 0.0005 - 0.68.
- The lowest average performance when the contractor was supervised by the client (owner) and the second lowest average when he was supervised by a consultant.

Table 4.1: Ranking of Bid Awarding System

Rank	Owners Satisfaction	Contractor Performance	Rate of Written Warnings	Rate of Warranty Calls	Rate of Major Problems	Effect on Project Execution	Contractor Performance according to supervisory group	
							Owner	Consultant
1	(L.B.&M.C.) 4.50000000	(L.B.&M.C.) 4.02777777	(L.B.&M.C.) 4.75000000	(L.B.&M.C.) 3.83333333	(L.B.&M.C.) 4.91666667	(L.B.&M.C.) 4.16666667	(L.B.&M.C.) 3.62500000	(L.B.&M.C.) 4.83333333
2	(L.B.&G.E.) 4.35714286	(L.B.&G.E.) 3.90476190	(L.B.&G.E.) 4.57142857	(L.B.&G.E.) 3.71428571	(L.B.O.) 4.22727273	(L.B.&G.E.) 3.71428571	(L.B.&G.E.) 3.37500000	(L.B.&G.E.) 4.61111111
3	(L.B.&P.) 3.91666667	(L.B.&P.) 3.60416667	(L.B.&R.C.) 4.17391304	(L.B.&C.T.E.) 3.62500000	(L.B.&R.C.) 4.21739130	(L.B.&P.) 3.45833333	(L.B.&R.C.) 3.16666667	(L.B.&R.C.) 4.28571429
4	(L.B.&R.C.) 3.78260870	(L.B.&R.C.) 3.50724630	(L.B.&P.) 3.91666667	(L.B.&R.C.) 3.52173913	(L.B.&G.E.) 3.78571429	(L.B.&R.C.) 3.43479261	(L.B.&C.T.E.) 3.15384615	(L.B.&P.) 3.89583333
5	(L.B.&C.T.E.) 3.56250000	(L.B.&C.T.E.) 3.29166667	(L.B.&C.) 3.80322581	(L.B.O.) 3.18181818	(L.B.&P.) 3.75000000	(L.B.&C.T.E.) 3.18750000	(L.B.&P.) 3.02083333	(L.B.&C.T.E.) 3.88888889
6	(L.B.&C.) 3.46236559	(L.B.&C.) 3.04480287	(L.B.&C.T.E.) 3.81250000	(L.B.&P.) 3.16666667	(L.B.&C.T.E.) 3.68750000	(L.B.O.) 2.63636364	(L.B.&C.) 3.01960784	(L.B.&C.) 3.07539683
7	(L.B.&O.R.) 3.18918919	(L.B.&O.R.) 2.82828283	(L.B.&O.R.) 3.69369369	(L.B.&O.R.) 3.03603604	(L.B.&O.R.) 3.23423423	(L.B.&C.) 2.29032258	(L.B.&O.R.) 2.87179487	(L.B.O.) 2.91666667
8	(L.B.O.) 3.09090909	(L.B.O.) 2.81060606	(L.B.O.) 3.45454545	(L.B.&C.) 3.02150538	(L.B.&C.) 3.20430108	(L.B.&O.R.) 2.21621622	(L.B.O.) 2.80000000	(L.B.&O.R.) 2.72727273

Table 4.2: Prob. Values

Sl.No.	Evaluation Group	Q.8	Q.10	Q.11	Q.15	Q.16	Q.17
1	(L.B.O.) X (L.B. & O.R.)	0.6810	0.9370	0.3952	* 0.3685	* 0.9752	* 0.8216
2	(L.B.O.) X (L.B. & P.)	0.0167	0.0105	0.1985	* 0.9695	* 0.6915	0.0647
3	(L.B.O.) X (L.B. & C.T.E.)	0.1805	0.1278	0.3609	0.2647	* 0.7626	0.1613
4	(L.B.O.) X (L.B. & R.C.)	0.0331	0.0268	0.0383	0.3278	* 0.9781	0.0632
5	(L.B.O.) X (L.B. & M.C.)	0.0005	0.0021	0.0017	0.1008	0.0747	0.0027
6	RI-O x R6-A (L.B.O.) x (L.B. & G.E.)	0.0009	0.0047	0.0064	0.1608	0.1327	0.0373
7	(L.B.O. x (L.B. & C.)	0.1390	0.3614	0.1185	* 0.3996	* 0.9751	* 0.6655

* Has negative t-values

- The lowest level of performance among all the groups with level of significance ranges between 0.002 - 0.40 with the exception of the lowest bidder and other requirements group which is almost equal to the lowest bidder only.
- The highest average percentage of written warnings among all the groups with level of significance ranges between 0.002 - 0.40.
- The receipt on average of fewer warranty calls for any problem during the warranty period than the lowest bidder and other requirements group with a low level of significance equal to 0.63. This was less than the lowest classified bidder group with a low level of significance equal to 0.60. It received about an equal number of warranty calls to that of the lowest prequalified bidder group. It also received more warranty calls than the rest of the groups.
- On average more major problems after the warranty period than the lowest most competent bidder with a significance level of 0.07, and more than the lowest well-experienced bidder with a level of significance equal to 0.13. It had about an equal number of major problems to the lowest reasonable competitive offer bidder. It has fewer major problems than the rest of the groups.
- According to owners' opinions, this system had affected projects execution on average more than the other groups with significance level ranges between 0.003 to 0.16. This is

with the exception of the lowest bidder and other requirements and the lowest classified bidder groups which had less effect than the lowest bidder only.

From Table 4.3 the ranges of significance levels for Questions 8, 10, 11, 15, 16 and 17 are tabulated against the awarding groups. This means that we have 42 responses (6-questions x 7-groups).

- 25 of the responses (59.5%) support the author's hypothesis with level of significance ranges between 0.0 - 0.20.
- 2 responses (4.8%) support the hypothesis in a range of 0.25 - 0.35.
- 4 responses (7.5%) support the hypothesis with significance level ranges between 0.35 - 1.0. This means that 27 responses support the author's hypothesis that "public building construction projects in Saudi Arabia that have been awarded to the lowest bidder only have in general a lower performance evaluation than of that of the other projects that have been awarded with a specified qualification". This counts for 64.3% with level of significance ranges between 0.0 and less than 0.35
- 3 responses (7.1%) are neutral (equal).
- 8 responses (19.1%) reject the hypothesis.

It can be concluded that the lowest bidder only group had the lowest results when compared with:

Six out of seven groups (85.7%) on the basis of owner's

Table 4.3: Ranges of Significance Level (α)

Evaluation Group	Ranges of Significance Level									
	Negative	Equal	0.35 ≤ α	0.30 ≥ α ≥ 0.25	0.25 ≥ α ≥ 0.20	0.20 ≥ α ≥ 0.15	0.15 ≥ α ≥ 0.1	0.1 ≥ α ≥ 0.05	0.05 ≥ α ≥ 0.0	
1) (L.B.O.) x (L.B.&O.R.)	Q15 Q16 Q17	Q10	Q11 Q 8							
2) (L.B.O.) x (L.B.&P.)	Q16	Q15				Q11		Q17	Q10 Q 8	
3) (L.B.O.) x (L.B.&C.T.E.)	Q16		Q11	Q15		Q17 Q 8	Q10			
4) (L.B.O.) x (L.B.&R.C.)		Q16	Q15					Q17	Q10 Q11 Q 8	
5) (L.B.O.) x (L.B.&M.C.)							Q15	Q16	Q10 Q11 Q17 Q18	
6) (L.B.O.) x (L.B.&G.E.)						Q15	Q16		Q10 Q11 Q17 Q18	
7) (L.B.O.) x (L.B.&C.)	Q15 Q16 Q17		Q10				Q11 Q 8			
Total	8	3	4	1	-	4	5	3	13	

degree of satisfaction with the overall quality of work completed. (Q.8).

Five out of seven groups (71.4%) on the basis of their performance in project execution (Q.10).

Five out of seven groups (71.4%) of rate of written warnings that are usually issued by the owners to contractors in cases of violation of contract agreements (Q.11).

Five out of seven groups (71.4%) on the basis of the effect on project execution as per owner's opinion (Q.17).

Two out of seven groups (25.6%) on the basis of rate of receipt of warranty calls during the warranty period (Q.15).

Two out of seven groups (25.6%) on the basis of rate of major problems faced after warranty period (Q.16).

And finally, it can be concluded that the supervisory group had in general no positive effect in improving the lowest bidder performance.

4.3 General Recommendations

The following recommendations are the most important ones in the author's opinion:

- 1) There should be a source of information in each government sector to provide researchers with the needed information about that sector.
- 2) Awareness of the importance of research should be

increased among government employees.

- 3) Computers should be used in storing information about previous projects including cost, periods, level of execution, number of changed orders and written warnings issued and reasons for issuance.
- 4) Centralization of projects affairs should be minimized by giving the Government sector authority to run projects from A to Z as most Ministry engineers who study offers or supervise the projects are mostly of equal degree and experience with their colleagues in the branches.
- 5) Information should be decentralized because sometimes it is necessary to go to Minister to take his approval for a very simple information.
- 6) Seminars should be held for engineers by the Ministry of Finance to explain Government policy about contracting and related issues. This can be part of a course in the engineering schools.
- 7) Experienced engineers should be given the last word in selecting the best bid as they have different backgrounds about engineering issues and know how to evaluate contractors.
- 8) All bidding documents should be revised as every Government sector has its own documents and its own method of explanation.
- 9) Prequalification of contractors should be essential as it is

the best way of evaluation.

- 10) There should be an information center for market prices to enable owners and engineers to compare contractors' unit prices with daily prices and to reach at the best estimates.
- 11) Estimates based on updated price information should be considered when selecting the best offer.

4.4 Recommendations for Further Study

This research disclosed that the following areas need further study:

- 1) Since it was found that there is a clear sign of the negative effect of the lowest uncontrolled bidder system on projects in general, it is suggested that boundaries of such studies should be widened to include all Saudi Arabia and random sampling of projects can be applied.
- 2) Since the other party to the construction contract, the contractor, was not covered by this research, it is suggested that similar studies be conducted to determine his opinion about the lowest bidder system.
- 3) As the effect of classification is not recognized on contractors performance on executed projects, it is suggested that further studies should measure the success of the classification system.
- 4) The relationship between the contract cost, actual cost and

maintenance costs is a very important field for further studies.

- 5) It was felt by the author that some executive engineers did not fully understand the meanings of bidding regulations issued by the Ministry of Finance. Studies to find the degree of understanding of this regulation can help in improving bidding techniques.
- 6) Since the cost estimate of the project to be awarded is a good indicator of the seriousness and dependability of participated offers, it is strongly suggested that the creation of unit rate schedules is a very important issue for further studies.
- 7) Throughout the survey, not all the information needed was available in some Government sectors. This might have a negative effect on project execution. The effect of centralization of management on construction is a valid issue for future studies.

APPENDIX - A:

FINAL QUESTIONNAIRE FORM

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

السادة /

السلام عليكم ورحمة الله وبركاته :

يهدف الاستبيان الذي بين ايديكم الى تحديد الاعتبارات التي تم ترسيبها المراجع على أساس
وقياس مستوى أداء القائلين في تنفيذ المراجع التي رسيب عليهم على أساس أي من
الاعتبارات .

ان تمهيداً الواعي للإجابة على اسئلة الإستبيان بدقة سيساعد كثيراً في تحليل نتائج
الإستبيان بواسطة الحاسب الآلي واستخدامها في الدراسة التي أقوم بها لنيل درجة الماجستير في
إدارة التشبيد والتي أسأل المولى سبحانه أن يفيد منها الأشخاص والجهات ذات العلاقة في المس
إن شاء الله تعالى .

شاكراً لكم حسن تعاونكم .

رضا بن أمين عبطة
جامعة الملك فهد للبترول والم
ص . ب . : ٥٥٦
الظهران ٣١٢٦١
هاتف رقم : ٨٦.٣٧٤٨
٨٦.٣٤.٥

Purpose:

The objective of this questionnaire is to identify the requirements that should be considered when selecting the lowest bidder in order to award the contract to the most responsible bidder.

Your kind response to these questions will be highly appreciated.

1) NAME OF CLIENT	(١) اسم المالك :
2) NAME OF PROJECT :	(٢) اسم المشروع :
3) DATE OF CONTRACT :	(٣) تاريخ توقيع العقد :
4) DATE OF PRELIMINARY RECEIPT :	(٤) تاريخ الإستلام الإبدئي :
5)	(٥) أ - تكلفة الإنشاء الأصلية
A. ORIGINAL CONSTRUCTION VALUE	
B. ORIGINAL CONSTRUCTION PERIOD .	ب - مدة الإنشاء الأصلية
6)	(٦) أ - تكلفة الإنشاء الفعلية
A. FINAL (ACTUAL) CONSTRUCTION VALUE	
B. FINAL (ACTUAL) CONSTRUCTION PERIOD.	ب - مدة الإنشاء الفعلية
7) What was the number of participating bidders ?	(٧) كم كان عدد العروض المتقدمة ؟
8) What was the degree of satisfaction with the overall quality of the work completed ?	(٨) ما مدى رضاكم عن نوعية العمل المنفذ بشكل عام ؟
Excellent	<input type="radio"/> ممتازة -
Very Good	<input type="radio"/> جيد جداً -
Good	<input type="radio"/> جيد -
Fair	<input type="radio"/> مرضيه -
Poor	<input type="radio"/> رديئه -
9) The project was supervised by :	(٩) تم الإشراف على المشروع .
Client (Owner)	<input type="radio"/> المالك -
Consultant	<input type="radio"/> استشاري -
Others	<input type="radio"/> جهة أخرى -

Performance of contractor
through :

(١٠) أداء المقاول من خلال :

	ممتاز Excellent	جيد جداً V. Good	جيد Good	مرضي Fair	رديء Poor	
Quality of work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	- جودة العمل
Adherence to instructions & specifications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	- الالتزام بالتعليمات والمواصفات
Organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	- التنظيم
Activity						- نشاطه وفعاليته
Work follow up and submissions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	- متابعة العمل والتقديمات
Cooperation with Owner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	- تعاونه مع المالك
Progress of work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	- تقدم العمل

(١١) How often did you issue
a written warning to the contractor ?

(١١) ما معدل الإنذارات المكتوبة
التي تم توجيهها إلى المقاول ؟

Very Often	<input type="radio"/>	- كثيراً جداً
Often	<input type="radio"/>	- كثيراً
Some times	<input type="radio"/>	- بعض الأحيان
Not Much	<input type="radio"/>	- قليلاً
Never	<input type="radio"/>	- أبداً

The contract was awarded to the lowest bidder because one or more of the following:

(١٢) تم ترسية المشروع على أقل العروض المتقدمة لسبب أو أكثر من الأسباب التالية :

- It is a Convernment practice. ☐ - لانه اجراء نظامي
- The contractor was prequalified. ☐ - المقاول جرى له تأهيل مبدئي
- The offer was colse to our estimate . ☐ - العرض قريب من التكلفة المقدره
- It was a reasonable competitive offer . (No large difference from others) ☐ - العرض كان معقولا بحيث لم يكن هنالك فرق كبير بينه وبين الآخرين
- The contractor was the most compentent . ☐ - المقاول كان أكفأ المتقدمين
- The clienet (yourself) had good experinence with the contractor . ☐ - للخبرة السابقة الجيده بالمقاول
- The contractor was classified . ☐ - لان المقاول مصنف
- Others (specify) . ☐ - أسباب أخرى (وضحها) :

What other requirements do you prefer to use to improve the lowest bid awarding system ?

(١٣) ماهي الشروط التي ترى وجودها لتطوير نظام ترسية العقود على أقل العروض

.....

4) What was your initial
estimated cost for
this Project ?

(١٤) كم كانت تقديراتكم الأولية لتكلفة
هذا المشروع ؟

Estimated Figure القيمة التقديرية

Date of Estimate تاريخ التقدير

15) How often was the contractor
requested to attend warranty
calls during the warranty
period ?

(١٥) إلى أي حد كنتم تستدعون المقاول
لعمل إصلاحات خلال فترة الضمان ؟

Very Often	<input type="radio"/>	- كثيرا جدا
Often	<input type="radio"/>	- كثير
Some times	<input type="radio"/>	- بعض الأحيان
Not Much	<input type="radio"/>	- قليلا
Never	<input type="radio"/>	- أبدا

6) How often did you face
a major problem after the
warranty period ?

١٦) إلى أي حد واجهتم مشاكل كبيرة
بعد انتهاء مدة الضمان ؟

- | | | |
|------------|-----------------------|---------------|
| Very Often | <input type="radio"/> | - كثيرا جدا |
| Often | <input type="radio"/> | - كثير |
| Some times | <input type="radio"/> | - بعض الاحيان |
| Not Much | <input type="radio"/> | - قليلا |
| Never | <input type="radio"/> | - أبدا |

17) To what extent do you
think awarding the contract
to the lowest bidder
affected the project
execution ?

١٧) إلى أي حد تعتقدون أن ترسية
المشروع على المقاول صاحب أقل
العطاءات اثر على سير المشروع ؟

- | | | |
|------------|-----------------------|---------------|
| Very Often | <input type="radio"/> | - كثيرا جدا |
| Often | <input type="radio"/> | - كثير |
| Some times | <input type="radio"/> | - بعض الاحيان |
| A little | <input type="radio"/> | - قليلا |
| Not at all | <input type="radio"/> | - لا شيء |

APPENDIX - B:
COMPUTER PROGRAM

MAIN10T SAS A1 KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS, DHAHRAN

```

FI DD DISK SUR1 DATA A1;
CTIONS NOTEXT82;
ONS CENTER NODATE;
E1 J=C 'KING FAHD UNIVERSITY OF PETROLEUM & MINERALS';
E2 J=C 'COLLEGE OF ENVIRONMENTAL DESIGN';
E4 J=C 'PERFORMANCE STUDY OF';
E5 J=C 'LOWEST BIDDER BID AWARDDING SYSTEM IN GOVERNMENT PROJECT';

```

MAIN;

FILE DD;

ST;

PUT

```

Q1R S 1-3
Q2R S 5-7
Q5A 23-32
Q5B 34-37
Q6A 39-48
Q6B 50-53
@ 58 Q8R 1.
@ 60 Q9R 1.
@ 62 Q10R1 1.
@ 63 Q10R2 1.
@ 64 Q10R3 1.
@ 65 Q10R4 1.
@ 66 Q10R5 1.
@ 67 Q10R6 1.
@ 71 (Q12R1-Q12R8) (1.)
@ 69 Q11R 1.
@ 96 Q15R 1.
@ 78 Q16R 1.
@ .00 Q17R 1.;

```

Q10R=(Q10R1+Q10R2+Q10R3+Q10R4+Q10R5+Q10R6)/6;

ONLY;

SET MAIN;

Q12R1=1 AND Q12R2=0 AND Q12R3=0 AND Q12R4=0 AND Q12R5=0
AND Q12R6=0 AND Q12R7=0 AND Q12R8=0 THEN DO;

Q12R='O';

OUTPUT; END;

Q12R_7;

SET MAIN;

IF Q12R7=7;

Q12R='A';

ALL;

SET ONLY Q12R_7;

PRINT DATA=ALL;

VAR Q12R1 Q12R7 Q12R;

TEST DATA=ALL;

CLASS Q12R;

VAR Q8R Q9R Q10R Q11R Q15R Q16R Q17R;

TITLE 'EVALUATION OF Q12R1 ONLY VS Q12R7 & OTHERS';

ROC TTEST DATA=ALL;

CLASS Q9R;

VAR Q10R;

TITLE 'EVALUATION OF Q9R VS Q10R';

ROC FREQ;

TABLES Q9R;

ROC CHART;

VBAR Q12R/ TYPE=MEAN SUBGROUP=Q8R SUMVAR=Q8R;

VBAR Q12R/ TYPE=MEAN SUBGROUP=Q9R SUMVAR=Q9R;

VBAR Q12R/ TYPE=MEAN SUBGROUP=Q10R SUMVAR=Q10R;

VBAR Q12R/ TYPE=MEAN SUBGROUP=Q11R SUMVAR=Q11R;

VBAR Q12R/ TYPE=MEAN SUBGROUP=Q15R SUMVAR=Q15R;

VBAR Q12R/ TYPE=MEAN SUBGROUP=Q16R SUMVAR=Q16R;

VBAR Q12R/ TYPE=MEAN SUBGROUP=Q17R SUMVAR=Q17R;

TITLE 'CHART OF AVERAGES (MEANS)';

ROC FORMAT;

VALUE Q12R A='LOWEST BIDDER & CLASSIFIED'

0='LOWEST BIDDER ONLY';

VALUE Q8R A='OWNERS SATISFACTION';

VALUE Q9R 1='OWNERS SUPERVISION'

2='CONSULTANT SUPERVISION';

ODSAS;

*****;
*****;

FILE: FINAL SAS A1 KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS, DHAHRAN

```

** WIDTH 60 DEPTH 60 ***;
MS F1 DD DISK SUR1 DATA A1;
OPTIONS DEVICE=IBM3179;
OPTIONS DEVICE=GDDMFAM4 GDDMN=IBM3812 GDDMT=IMG240X;
OPTIONS NOTEXT82;
OPTIONS DEVICE=IBM3190 BORDER NOTEXT82 VPOS=80 HPOS=120;
OPTIONS DEVICE=IBM3287 DEVADDR='4FF' BORDER NOTEXT82 ;
OPTIONS DEVICE=GDDM87 DEVADDR=(... 'FINAL') BORDER NOTEXT82;
FILE1 H=2.0 C=BLACK F=COMPLEX ' ';
PERFORMANCE STUDY OF' ;
FILE2 H=2.0 C=BLACK F=COMPLEX
WEST BIDDER BID AWARDDING SYSTEM IN GOVERNMENT PROJECT';
DATA MAIN;
INFILE DD;
INPUT

```

```

Q1R S 1-3
Q2R S 5-7
Q5A 23-32
Q5B 34-37
Q6A 39-48
Q6B 50-53
@ 58 Q8R 1.
@ 60 Q9R 1.
@ 62 Q10R1 1.
@ 63 Q10R2 1.
@ 64 Q10R3 1.
@ 65 Q10R4 1.
@ 66 Q10R5 1.
@ 67 Q10R6 1.
@ 71 (Q12R1-Q12R8) (1.)
@ 69 Q11R 1.
@ 96 Q15R 1.
@ 98 Q16R 1.
@ 100 Q17R 1.;
Q10R=(Q10R1+Q10R2+Q10R3+Q10R4+Q10R5+Q10R6)/6;
LABEL Q8R='OWNER SATISFACTION'
Q10R='PERFORMANCE'
Q11R='WRITTEN WARNINGS'
Q15R='WARRANTY CALLS'
Q16R='MAJOR PROBLEMS'
Q17R='EFFECT ON EXECUTION';

```

```

A ONLY;
SET MAIN;
IF Q12R1=1 AND Q12R2=0 AND Q12R3=0 AND Q12R4=0 AND Q12R5=0
AND Q12R6=0 AND Q12R7=0 AND Q12R8=0 THEN Q12R=1 ;
ELSE IF Q12R5=5 THEN Q12R=2 ;
LABEL Q12R='AWARDDING SYSTEM';

```

```

PROC FORMAT;
VALUE Q12R 1='L.B.O.'
2='L.B & M.C.';
VALUE Q9R 1='OWN. SUPERV'
2='COSUL. SUPERV.';

```

```

PROC GCHART ;
VBAR Q12R/ DISCRETE NOLEGEND TYPE=MEAN SUBGROUP=Q9R SUMVAR=Q9R;
FORMAT Q12R Q12R. Q9R Q9R.;
FOOTNOTE C=R H=1 F=COMPLEX
'FIGURE NO 3.26 OWNER SATISFACTION VS. BID AWARDING SYSTEM';
PROC GCHART ;
VBAR Q12P/ DISCRETE NOLEGEND TYPE=MEAN SUBGROUP=Q9R SUMVAR=Q9R;
FORMAT Q12R Q12R. Q9R Q9R.;
FOOTNOTE C=R H=1 F=COMPLEX 'FIGURE NO 3.143';
PROC GCHART ;
VBAR Q12R/ DISCRETE NOLEGEND TYPE=MEAN SUBGROUP=Q10R SUMVAR=Q10R;
FORMAT Q12R Q12R. Q9R Q9R.;
FOOTNOTE C=R H=1 F=COMPLEX
'FIGURE NO 3.39 PERFORMANCE VS. BID AWARDING SYSTEM';
PROC GCHART ;
VBAR Q12R/ DISCRETE NOLEGEND TYPE=MEAN SUBGROUP=Q11R SUMVAR=Q11R;
FORMAT Q12R Q12R. Q9R Q9R.;
FOOTNOTE C=R H=1 F=COMPLEX
'FIGURE NO 3.40 WRITTEN WARNINGS VS. BID AWARDING SYSTEM';
PROC GCHART ;
VBAR Q12R/ DISCRETE NOLEGEND TYPE=MEAN SUBGROUP=Q15R SUMVAR=Q15R;
FORMAT Q12R Q12R. Q9R Q9R.;
FOOTNOTE C=R H=1 F=COMPLEX
'FIGURE NO 3.41 WARRANTY CALLS VS. BID AWARDING SYSTEM';
PROC GCHART ;
VBAR Q12R/ DISCRETE NOLEGEND TYPE=MEAN SUBGROUP=Q16R SUMVAR=Q16R;
FORMAT Q12R Q12R. Q9R Q9R.;
FOOTNOTE C=R H=1 F=COMPLEX
'FIGURE NO 3.42 MAJOR PROBLEMS VS. BID AWARDING SYSTEM';
PROC GCHART ;
VBAR Q12R/ DISCRETE NOLEGEND TYPE=MEAN SUBGROUP=Q17R SUMVAR=Q17R;
FORMAT Q12R Q12R. Q9R Q9R.;
FOOTNOTE C=R H=1 F=COMPLEX
'FIGURE NO 3.43 EFFECT ON PROJECT EXECUTION VS. BID AWARDING SYSTEM';

```

REFERENCES

- 1) Adashi. S., and Kenel Terazana, "Difference in Contractual Practices in Tunnelling Among Various Contract Awarding Agencies", International Tunnelling Symposium, Tokyo, 1978.
- 2) Ahmed Munir (1987), "Sample Survey Methods", unpublished manuscript, Department of Mathematical Sciences, KFUPM, Dhahran, Saudi Arabia.
- 3) Al-Hazmi, M., "Causes of Delay in Large Building Construction Projects", KFUPM, Dhahran, Saudi Arabia.
- 4) Alice Tulock, "Is Competitive Price Bidding for Professional Services", Journal of Professional Activities, Vol. 106, No.E11, January, 1980.
- 5) Altaf Hussain, F. ASCE, "Excelling as a Construction Contractor", Journal of the Construction Division, Vol. 100, No. CO4, December, 1974.
- 6) Clough, Richard H., "Construction Contractor", John Wiley & Sons, Inc., 4th Edition, 1981.
- 7) DIN 1960 - Verdingungsordnung fuer Bauleistungen Bauleistungen (VoB) Allgemeine Bestimmungen Fur die Verregable von Bauleistungen.

"DIN 1960" means "Norm of Regulation Nr. 1960" of the German Institute of Norming".

"Verdingungsordnung fuer Bauleistungen" means "Rules and Regulations on Bidding and Tendering in Building Construction", "Allgemeine Bestimmungen fuer die Vergabe von Bauleistungen" means "General Rules on Bidding and Tender in Building Construction".
- 8) DIN 1961 - Verdingungsordnung fuer Bauleistungen (VoB) Vertragsbestimmungen fuer die Ausfuehrung von Bauleistungen.

"Vertragsbestimmungen fuer die Ausfuehrung von Bauleistungen" means "Regulations for Contracts regarding the Construction of Buildings".
- 9) Construction Under Third Development Plan", Saudi Economic Survey, Vol. 14, No. 695, December 24, 1980.

- 10) Donald, S. Barrie and Boyd, C. Paulson, Jr., "Professional Construction Management", McGraw-Hill, 1984.
- 11) Fourth Development Plan 1405-141- A.H. (1985-1990 A.D.) "Ministry of Planning, Riyadh, 1985.
- 12) Gates, M. Gates, "Building Model - A Monte Carlo Experiment" Journal of the Construction Division, ASCE, Vol. 102, No. CO1, March, 1976.
- 13) J. C. Slack, B.Sc., MICE and R. W. Giled, B.Sc., FICE, FCIQB, "Management Contracting in Civil Engineering", Proc., Instn. Civ. Engrs. Part 1, 1981, 70, August.
- 14) James, E. Dukmann, "Cost-Plus Contractor Selection: An Analytical Method", Engineering Cost and Production Economics, 7 (1983), Elsevier Scientific Publishing Company, Amsterdam.
- 15) Kenneth, C. Giberson, A. M., ASCE, "Competitive Bidding for A/B Services - Why Not ", No. EI, 1 January, 1980.
- 16) Michael Ritchie, "Saudi Budget Draws Mixed Response:", MEED, 10 January, 1987.
- 17) Ministry of Finance and National Economy, "Bids and Tender Policy", First Edition Makkah Al-Mokarramah 1400 A.H.
- 18) Mohamad Al-Jarallah, "Construction Industry in Saudi Arabia", Journal of Construction and Engineering Management, Vol. 109, No. 4, December 1983.
- 19) Peter, H. Grinyer and John, D. Whittaker, "Managerial Judgement in a Competitive Bidding Model", Operational Research Quarterly, Vol. 24, No. 2.
- 20) Peter Thompson, "Organization and Economics of Construction", McGraw-Hill, New York, 1981/
- 21) Purshottam, S. Gore, "Rationale of Contract Awards and Contract Systems", Journal of Construction Division, Vol. 106, No. CO4, December, 1980.
- 22) Robert, I. Corr, M.ASCE, "Impact of Number of Bidders on Competition", Journal of Construction Engineering and Management, Vol. 109, No. 1, March, 1983.
- 23) S. C. Hardy, A. Norman, and J. G. Perry, "Evaluation of Bids for Construction Contractors using Discounted Cash Flow Techniques", Proc. Instn. Civ. Engrs. Part 1, 1981,

70, February.

- 24) Sama Annual Report 1406 A.H., "The Annual Report of the Saudi Arabian Monetary Agency 1406 (1986)", Riyadh, Rajab 1407, (March 1987).
- 25) Surinder Singh and G. C. Sofat, "Comparative Performance Study of Different Building Contract Systems", Indian Concrete Journal, October 1, 1977.
- 26) The Statistical Book of 1404 A.H. (1984 A.D.), Department of Statistics, Ministry of Finance and National Economy, Riyadh, 1984.
- 27) Van Uu Nguyen, M.ASCE, "Tender Evaluation by FUZZY SETS", Journal of Construction and Engineering Management, Vol. 111, No. 3, September, 1985.
- 28) Wadde, R. L., and Haris, R. B., "Lomark - A Bidding Strategy", Journal of the Construction Division, ASCE, Vol. 102, NO. CO1, March 1976.
- 29) W. C. Cochran, "Sampling Techniques" Third Edition, John Wiley and Sons, New York, 1977.
- 30) William, R. Park, P. E., "Construction Bidding for Profit", John Wiley and Sons, New York 1979.